Heating and Ventilating

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

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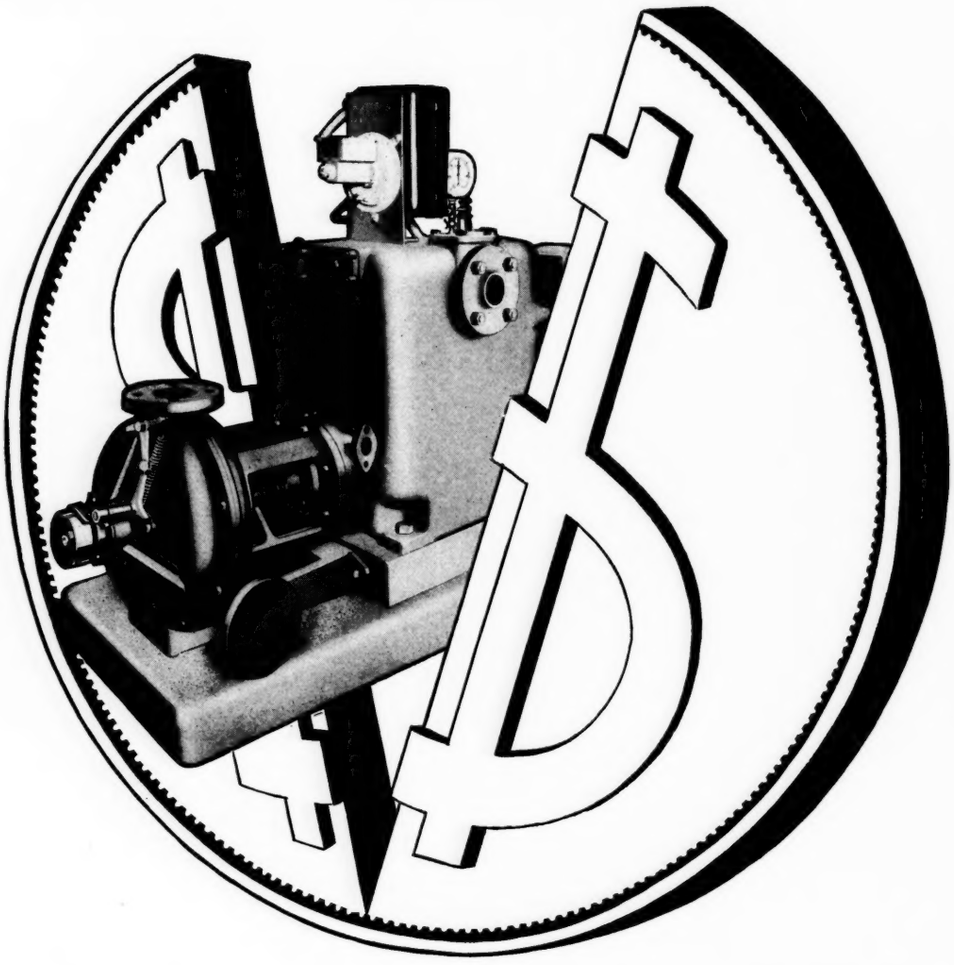


This Pump Splits Heating Costs.

Requires no electric current—Saves steam!

That the remarkable new Jennings Vapor Turbine eliminates electrical current, the one largest cost item in the operation of a return line heating pump, justifies the enthusiasm with which it is being received by engineers all over the country. This saving, however, is only the beginning when you purchase a Vapor Turbine. For this pump operates continuously, and thus affords all the economies in heating which have been recognized by engineers to be a part of continuous operation, but which have heretofore been impossible because the high cost of current consumed offset economies to be derived from a continuously operating unit.

This new pump is driven by a newly developed vapor turbine which functions on a differential of only 5" of mercury, and on any type of vacuum heating system, regardless of type of steam control. It is equally efficient on low pressure steam, high pressure steam thru reducing valve, or on street steam. It makes no difference whether the system is run above or below atmosphere, because the turbine functions on the difference between the supply and the inlet, not on a given pressure above atmosphere.

Besides its other advantages, this equipment gives you safety in your heating system. It is independent of possible current failures. It functions as long as there is steam in the heating system, assuring constant and reliable vacuum and boiler return.

Bulletin 203 gives you interesting details concerning this pump. Send your name and address for your copy.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT

Reference Lists of Oil Burning Equipment

Purpose of the Listings

ON the next several pages are reference lists which give the principal mechanical data on those items of currently available oil-burning equipment about which readers most frequently inquire by letter.

Heretofore, we have used the method of furnishing such data only on inquiry and by private correspondence. These lists are newly prepared and we believe that they are the most complete and comprehensive ones which have appeared to date.

Even so, no claim of completeness is made, and we are fully aware that these lists are not comprehensive in covering either all oil-burning equipment or every company name and model. They are frankly lists which include those kinds of equipment with which our readers are most concerned as shown by their letters of inquiry to us. We have not included any range-burning equipment or room heaters. Some of the groups listed were also deliberately restricted to exclude some types and models both because of the necessity of keeping the lists compact, and because we find that we receive fewer requests for information concerning them.

When the general types of equipment to be included in the lists were determined, we addressed a letter to all manufacturers of whom we had record, explaining our intention to gather information, and inviting cooperation in securing it. Those who accepted, and the acceptance was general and gratifying, were included in the listing after we were satisfied that their products really fell into one or more of the several groups selected for listing. As a result of the general cooperation received we believe that the several lists show a true cross-section of the equipment at the present time. After the data were tabulated they were submitted back to the manufacturers for correction or comment before the final lists were prepared.

Inclusion of a product in these lists, therefore, means essentially that it falls into the particular grouping used, and that its maker cooperated in furnishing information. Exclusion means that either it did not fall into the grouping, or we were not favored with its maker's cooperation. In no sense, therefore, are the lists to be construed as merit listings. Instead they represent the results of a straightforward attempt to gather essential items of information into a compact and usable form in order that you may have them for reference purposes.

Study of inquiries received from readers over a considerable period showed that while many detailed questions were asked, there were two which in one form or another were by all means the most numerous. They are approximately as follows:

(1) Please let me know what oil-burning equipment you consider the best on the market, and

(2) Can you tell me what manufacturers make equipment which is suitable for a job having — sq. ft. of radiator?

To the first of these queries we have no direct answer and believe that none can be honestly given. Too many factors are involved to permit doing so. Consequently, there is nothing in the following reference lists which will answer this request for information.

We can do no better than to repeat the advice given in correspondence. "We believe that the purchase of oil-burning equipment should be looked on in the same way as is the purchase of anything else. We doubt if it is possible to categorically state that any one piece of oil-burning equipment is 'best' any more than it is possible to so state that one particular automobile is best. Value in an oil burner is determined by many factors which cannot be even approximately scaled or tabulated. Among these the integrity, reputation, and soundness of the manufacturer and the fairness of his operations are just as important as good materials, design and engineering even though they cannot be set down separately in dollars. Failure to take them into account is foolish in the extreme. The importance of correct and careful installation cannot be overlooked, for poor installation can overbalance and nullify the most painstaking attention to good construction of the equipment itself. Satisfactory provision for local servicing and quick emergency repair must be taken care of. Satisfy yourself on these points before you buy."

Happily we are able to be much more specific in dealing with the second question—that of size. Correct use of the lists will permit an adequate answer to the question of which manufacturers make burners suitable for use on jobs of known size. As all makes are not included in the lists the answer is not fully complete, nor can the data be arranged to permit exact sizing, but it can be closely estimated.

On pages 16 to 25 fuller explanations of the tables are given and we earnestly recommend that the lists be used only after the instructions there given are read over and understood. When this is done we are confident that you will find the lists valuable.

Arrangement of Lists

FOUR separate reference lists are included as follows:

(1) Factory-Assembled Burners, (2) Oil-Burning Systems, (3) Boiler-Burner Units, and (4) Oil-Burning Boilers.

The four lists are all made up in essentially similar form, with data on models and capacities on the left and company names on the right. Intermediate columns give details which necessarily have to vary with each list. In all cases the column headed "Remarks" carries enough explanation at the top so that the kind of equipment listed can be understood without the necessity of consulting the title of the list each time. This plan also makes it possible to list only departures, exceptions, or individual explanatory remarks after each model. This permits greater compactness in the lists. Models and capacities are placed at the left because they are the items most often wanted by the user. In each case enough details of the kind and nature of the equipment are included to reveal the principal mechanical features, except controls and accessories.

It will be noted that controls and accessories are not separately listed after each model although they are present and are certainly essential. There are a number of reasons for their omission from the lists. First, their inclusion would have made it necessary to sacrifice compactness to such an extent that the lists would have had to occupy considerably more space and be less usable in that respect. Second, we feel that the subject of controls is of enough importance and complexity to deserve separate treatment. Third, many of the controls used are not peculiar to oil-burning equipment but are used on other apparatus as well. Fourth, in many cases makers of oil-burning equipment have made arrangements for providing so many alternates in the way of both controls and accessories that their listing would be pointless. Fifth, publications issued by the Underwriters Laboratories already make available lists of the safety controls used on many burners. Sixth, there is a considerable tendency to submerge the names of the accessories used on many items of oil-burning equipment. Finally, the user is inclined to look on the controls and accessories as part of the principal device.

To a considerable extent the two latter tendencies are bad practices, and while controls and accessories are not listed, we want to mention one phase of the subject which is often overlooked. There is a considerable range of these pieces of equipment now available and substitution can be readily practiced. So also is it easy to omit some items. As a result it is well to inquire and be sure of just what items are included. This is especially true where a selection has narrowed itself down to one of two makes. Manufacturers can furnish lists of the controls included and should be consulted in cases where decision hinges on this point.

Many people have called attention to the fact that what is commonly called an "oil burner" is often really not an oil burner at all but a device for getting the oil ready to burn and discharging it into a space (the boiler) where the real burning takes place. This idea sets up oil burning as a sort of two-stage affair requiring two sets of equipment, and something resembling this is followed in these reference lists. Two of the lists deal only with what have usually been called "burners"—these on pages 17-19 and 21-22; one deals with both the burner and the boiler—page 25, and the other deals only with the boiler part of the combination—page 24.

Burner Lists

Classification

In the two lists of burners, the grouping into "Factory-Assembled Units" and "Oil-Burning Systems" is new. The reason for adopting these groupings is that none of the commonly-used methods of grouping seems logical, for the terms used are not clearly descriptive and there is a possibility of overlapping. With the method of listing used here the basis of division is whether or not the burners are so designed and built that the burner proper, pumps, fans, controls, and accessories are all grouped on one base and are either fully, or substantially fully, assembled at the factory and delivered to the job as a single "unit." Multiple installations call for the use of more than one of these units, and there are thus as many pumps, fans, and other auxiliaries as there are units installed. If the burner is of this kind it is listed as a "Factory-Assembled Unit." If burners and their accessory fans, pumps, and other auxiliaries are built and delivered separately so that one fan or pump can supply either one or a number of burners, and the "system" must be engineered and fitted up to meet the specific requirements, it is listed as an "Oil-Burning System."

This plan makes the basis of division clear-cut, is fairly descriptive and, moreover, agrees well with the groupings in common use. It has the added advantage that it does away with distinctions based on means of control, grade of oil used, inclusion of safety devices, and the confusing use of words like "domestic," "commercial" and "industrial," which are more misleading than descriptive.

The Factory-Assembled Burner List and How to Use it

The listing includes mainly only those units which are atomizing and not vaporizing; which use a pump or similar device for oil feed, and which use a fan for

REFERENCE LIST—FACTORY-ASSEMBLED OIL BURNER UNITS

BURNER MODEL — FOR GROSS BOILER LOADS SHOWN BELOW (SEE UNDER "REMARKS")				FUEL		ATOMIZING AND IGNITION METHOD	REMARKS	MANUFACTURER
UP TO 1000 SQ. FT.	1000 TO 3000 SQ. FT.	3000 TO 6000 SQ. FT.	OVER 6000 SQ. FT.	RATE, GAL. PER HOUR, CATALOG LISTING.	NO., NOT HEAVIER THAN, (COM. STD. SPECS.)	ATOM. = ATOMIZING; PRESS. = PRESSURE; HOR. = HORIZONTAL; VER. = VERTICAL; ROT. = ROTARY; ELECT. = ELECTRIC; IGN. = IGNITION.	UNITS LISTED ARE FACTORY-ASSEMBLED, ATOMIZING BURNERS, WITH OIL PUMP AND FOR INTERMITTENT OPERATION UNDER AUTOMATIC CONTROL, UNLESS OTHERWISE NOTED. ALL ARE UNITS, I.E., COMPLETE AND READY FOR CONNECTION TO FUEL AND IGNITION SOURCE; HAVE SOME AUTOMATIC CONTROLS; INTENDED FOR CENTRAL HEATING—ISOLATED ROOM HEATERS AND RANGE BURNERS NOT LISTED. "SQ. FT." IN TABLE REFERS TO OUTPUT AT BOILER IN STEAM (240 B.T.U.) UNLESS NOTED AS "SQ. FT. NET."	TRADE NAME SAME AS COMPANY NAME UNLESS NOTED
SD5				1½ MAX.	2	VER. ROT. G. OR E.	USES 5" ATOMIZER	ANCHOR POST FENCE CO.
SD6				2½ MAX.	2		" 6" "	
SD7	SD7			4 MAX.	2		" 7" "	
	SC8			8 MAX.	3			
		SC9		15 MAX.	3			
O	O			1 TO 3½	3	OIL PRESS. AT NOZZLE E.		AUBURN BURNER CORP.
B	B	B		3 TO 8	3			
		C	C	8 TO 25	3		LISTED UP TO 10,000 SQ. FT.	
BI				1½ TO 2½	3	OIL PRESS. AT NOZZLE E.		THE AUTOCRAT OIL BURNER CORP.
	B2			3 TO 7	3			
	B3	B3		7 TO 15	3		UP TO 5000 SQ. FT.	
H				1 TO 2½	2	VER. ROT. G. OR E. OIL PUMP NOT INCLUDED	ONE SIZE, TO 600 SQ. FT.	AUTOMATIC BURNER CORP.
E3	E3			¾ TO 3	3		UP TO 1250 SQ. FT.	
	E4			3 TO 8	3		UP TO 3000 SQ. FT.	
		E5		6 TO 20	3	VER. ROT. G	UP TO 6000 SQ. FT. OIL PUMP NOT INCLUDED	
BABY GRAND				3 MAX.	3	OIL PRESS. AT NOZZLE E.		ARTHUR H. BALLARD, INC.
40	40			5 MAX.	3			
	6			8 MAX.	3			
	8	8		15 MAX.	4			
			10	30 MAX.	4			
	HAB	HAB		15 MAX.	5	HOR. ROT. G.	HA AND HC MANUAL OR SEMI-AUTOMATIC, SAME MAX. FUEL AS HAA AND HAC, BUT USE #6 OIL	
		HAA	HAA	30 MAX.	5			
			HAC	50 MAX.	5			
A5					2	OIL PRESS. AT NOZZLE E.	ONE SIZE, TO 800 SQ. FT.	BAKER OIL BURNERS, INC.
M10					2			
	M20				2			
L40					3			
	L50				3			
	L60	L60			3		UP TO 6000 SQ. FT.	
A				3 MAX.	3	OIL PRESS. AT NOZZLE E.	ONE SIZE	BOCK OIL BURNER CORP.
C	C			5½ MAX.	3			
	D	D		12 MAX.	3		UP TO 4000 SQ. FT.	
5	5				2	VER. ROT. E.	ROT. FLAME WITH SPECIAL MOLDED BOWL. 3 SIZES, 450 TO 7000 SQ. FT. NET	BRYAN STEAM CORP.
		7			2			
			9		2			
MI	M2			3½ ¢ 7 MAX.	3	OIL PRESS. AT NOZZLE G. OR E.	"CRESCENT" MODEL	CALOROIL BURNER DIV.
		M3	M3	35 MAX.	3		" "	
A	A				2	VER. ROT. G. OR E.	"VICTORY" MODEL. UP TO 2400 SQ. FT.	
B					2		" " UP TO 400 SQ. FT.	
CAL.	CAL.	CAL.	CAL.		3	VACUUM PRESS. G. OR E.	"CALOROIL" MODEL. OUTPUT DEPENDS ON BURNER HEAD	
A				½ TO 3	2	OIL PRESS. AT NOZZLE E.	PRIMARILY FOR DOMESTIC USE	CAMPBELL MACHINE CO.
B	B			3 TO 8	2		B AND C ARE TWO SIZES OF SAME BASIC DESIGN	
	C	C		8 TO 12	3			
B	B				2	VAPORIZATION IN A DOUBLE PERFORATED BOWL	8 SIZES TO 2700 SQ. FT.; WITH OR WITHOUT FAN. CONSTANT PRESS. GRAV. FEED, HIGH-LOW FLAME	CARY MFG. CO.
DI				3 MAX.	3	OIL PRESS. AT NOZZLE G. OR E.	DI, D2 AND D3 SAME BASIC DESIGN	CENTURY ENGINEERING CORP.
	D2	D2		12 MAX.	3			
		D3	D3	40 MAX.	3		D3 UP TO 15,000 SQ. FT.	
AI				5 MAX.	3		AI, A2, CI, C2, C3 SAME BASIC DESIGN	
	A2	A2		12 MAX.	3			
CI				4 MAX.	3			
	C2	C2		12 MAX.	3			
		C3	C3	40 MAX.	3		C3 UP TO 15,000 SQ. FT.	
BI				4½ MAX.	3		BI, B2 HAVE BELT-DRIVEN SLOW SPEED PUMP	
	B2	B2		10 MAX.	3		B2 UP TO 4000 SQ. FT.	
D				1 TO 3	3	OIL PRESS. AT NOZZLE E.		CHALMERS OIL BURNER CO.
	C	C		4 TO 20	3		UP TO 6000 SQ. FT. NET	
TDHT.	TDHT.	TDHT.	TDHT.			VER. ROT. G. OR E.	TDHT. INDICATES "TORIDHEET" MODEL	CLEVELAND STEEL PRODUCTS CORP.
B				3 MAX.	2			
C	C			6 MAX.	2			
T	T	T		12 MAX.	2			
DI				1½ TO 3	3	OIL PRESS. AT NOZZLE E.		DELCO APPLIANCE CORP.
	D2			2½ TO 6½	3			
	D3	D3		5 TO 15½	3			
			D4	15 TO 35	3		UP TO 12,000 SQ. FT.	
J	J	J	J		3	OIL PRESS. AT NOZZLE E.	UP TO 10,000 SQ. FT.	D'ELIA OIL BURNER CO., INC.
A				2½ MAX.	3	OIL PRESS. AT NOZZLE. LOW PRESS. AIR E.	MAKER'S BURNERS KNOWN AS "WALTHAM"	JULIAN D'ESTE CO.
D	D			5 MAX.	3			
	E			10 MAX.	3			
		F	F	28 MAX.	3		UP TO 10,000 SQ. FT.	
A				1 TO 3	3	OIL PRESS AT NOZZLE E.		EASTERN OIL EQ'PT, INC.
B	B			2½ TO 7	3			
	C	C		5 TO 15	3		UP TO 5000 SQ. FT.	
AI-4				3½ MAX.	2	ATOM. PUMP G.	ALL MODELS HAVE DISTINCTIVE ATOM. METHOD USING ROT. PUMP AND LOW PRESS. NOZZLE. NO FAN	ECONOMY BURNER CORP.
	AI-3			6 MAX.	2			
	AI-2	AI-2		9 MAX.	2			
TJ				1 TO 2½	3	OIL PRESS. AT NOZZLE E.	UP TO 800 SQ. FT. NET	ELECTROL INCORPORATED
TU	TU			2 TO 8½	3		600 TO 3000 SQ. FT. NET	
		TL		8½ TO 18	3		2800 TO 6000 SQ. FT. NET	
			TM	12 TO 24	3		4000 TO 10,000 SQ. FT. NET	
AAA				½ TO 2	5	HOR. ATOM. CUP, G, E, OR BOTH	GRAV. OIL FEED. AC OR DC. SEMI- OR FULL AUTOM. ONE SIZE	ENTERPRISE OIL BURNER CO.
JR. W				3 MAX.	3	OIL PRESS. AT NOZZLE E.	AC OR DC	
A	A	A	A	½ TO 200	5 OR 6	HOR. ATOM. CUP, G, E, OR BOTH	#5 OIL WITH AUTOM., #6 WITH MANUAL CONTROL. AC OR DC OR STEAM-TURBINE DRIVE. A IS FULL AUTOMATIC E AND G HAS MANUAL CONTROL. TO 80,000 SQ. FT.	
E	E	E	E					
G	G	G	G					
JR. JB				2½ MAX.	3	OIL PRESS. AT NOZZLE E.		GILBERT ¢ BARKER MFG. CO.
BS5	BS5			4½ MAX.	3			
	BS10	BS10		8 MAX.	3			
			CS	30 MAX.	3		UP TO 12,000 SQ. FT.	

REFERENCE LIST—FACTORY-ASSEMBLED OIL BURNER UNITS

BURNER MODEL — FOR GROSS BOILER LOADS SHOWN BELOW (SEE UNDER "REMARKS")				FUEL		ATOMIZING AND IGNITION METHOD	REMARKS	MANUFACTURER
UP TO 1000 SQ. FT.	1000 TO 3000 SQ. FT.	3000 TO 6000 SQ. FT.	OVER 6000 SQ. FT.	RATE, GAL. PER HOUR, CATALOG LISTING.	NO., NOT HEAVIER THAN, (COM. STD. SPECS.)	ATOM. = ATOMIZING PRESS. = PRESSURE HOR. = HORIZONTAL VER. = VERTICAL ROT. = ROTARY ELECT. = ELECTRIC IGN. = IGNITION.	UNITS LISTED ARE FACTORY-ASSEMBLED, ATOMIZING BURNERS, WITH OIL PUMP AND FOR INTERMITTENT OPERATION UNDER AUTOMATIC CONTROL, UNLESS OTHERWISE NOTED. ALL ARE UNITS, I.E., COMPLETE AND READY FOR CONNECTION TO FUEL AND IGNITION SOURCE; HAVE SOME AUTOMATIC CONTROLS; INTENDED FOR CENTRAL HEATING—ISOLATED ROOM HEATERS AND RANGE BURNERS NOT LISTED. "SQ. FT." IN TABLE REFERS TO OUTPUT AT BOILER IN STEAM (240 B.T.U.) UNLESS NOTED AS "SQ. FT. NET."	TRADE NAME SAME AS COMPANY NAME UNLESS NOTED
D1				1 TO 6	3	ROT. ATOM. PUMP E.		HART OIL BURNER CORP
	D2			5 TO 10	3			
	D3	D3		8 TO 20	3		UP TO 5000 SQ. FT.	
S				3½ MAX.	3	PRESS. ATOM. E.	TRADE NAME "MASTERKRAFT"	HARVEY WHIPPLE, INC.
	M1			8 MAX.	3			
		M2		16 MAX.	3			
G				3 MAX.	3	OIL PRESS. AT NOZZLE E.		INTERNATIONAL OIL HEATING CO.
	H			7 MAX.	3			
		K		18 MAX.	3		UP TO 6000 SQ. FT.	
B				6 TO 15 LB.	3	HOR. ROT. CUP G.E. OR BOTH	B2 LIKE B, BUT PEDESTAL MOUNTED TO 825 ℔	
28	28	28	28	10 TO 500 LB.	6	HOR. ROT. CUP MANUAL IGN.	IN 2 MODELS-ONE 5 SIZES TO 27,800 ℔, BUILT-IN PUMP OTHER, 6 SIZES TO 41,700 ℔ WITH REMOTE PUMP. HANDLES 10 TO 750 LB. PER HR.	S.T. JOHNSON CO.
30A	30A	30A	30A	10 TO 500 LB.	5	HOR. ROT. CUP G. OR G.E.	5 SIZES. E. IGN. OPTIONAL ON SMALL SIZES IF OIL IS NOT HEAVIER THAN #3. MODEL 30H, ALSO AVAILABLE IN 5 SIZES, USES #6 OIL, AUTO., COVERS SAME SIZES AS 30A. 30A & 30H UP TO 27,800 SQ. FT.	
75	75				3	OIL PRESS. AT NOZZLE E.		JOHNSON MFG. CO.
	20-1				3			
	20-2	20-2			3		UP TO 5000 SQ. FT.	
C					3	OIL PRESS. AT NOZZLE E.		KEWANEE OIL BURNER CORP.
D				¾ TO 2½	2			
	6	6	6			HOR. ROT. CUP	MANUAL OPERATION OPTIONAL, 1500 TO 8000 SQ. FT. FOR MODEL 6, 5000 TO 20,000 SQ. FT. FOR MODEL 10	
		10	10					
804	804			5 MAX.	3	OIL PRESS. AT NOZZLE E.	UP TO 1500 SQ. FT.	KLEEN-HEET, INC.
	805	805		17 MAX.	3		804, 805, 820 USE DISTINCTIVE NOZZLES TO OBTAIN DESIRED SHAPE AND SIZE OF FLAME	
			820	25 MAX.	3			
R				2 MAX.	2	VER. ROT. G.	TO 600 SQ. FT. 2 AIR ADJUSTMENTS, ADJ. HEAD AIR SHUTTER	
O						G. OR E.		LAMMERT & MANN CO.
I	I							
	2	2					UP TO 4000 SQ. FT.	
		3	3				UP TO 8000 SQ. FT.	
			4				UP TO 14000 SQ. FT.	
A					3	OIL PRESS. AT NOZZLE E.		MALLEABLE IRON FITTINGS CO.
R				3 TO 20	4	ROT. NOZZLE UNDER PRESS.	4 SIZES. ELECT. IGN.	THE MESSER CO.
HB1				1½ TO 5	3	OIL PRESS. AT NOZZLE E.		THE MICRO CORP.
HB2	HB2			3½ TO 10	3			
	HB3	HB3	HB3	8 TO 20	3			
H1	H2			1½ TO 8	3			
A1				1½ TO 3½	3	OIL PRESS. AT NOZZLE G. OR E.		
A2	A2			3½ TO 6	3			
	A3			6 TO 10	3			
	A4	A4		10 TO 15	3			
DR	DR	DR	DR	30 MAX.	4	HOR. ROT. CUP, G. OR E.	#5 AND 6 OIL MAY BE USED IF PREHEATED. GAS FOR AUTOM. OPERATION. HIGH-LOW OIL VALVE PERMITS SEMI-AUTOMATIC OPERATION. ALSO ARRANGED FOR MANUAL OPER. TO 13,000 SQ. FT.	NATIONAL AIROIL BURNER CO.
A					3	OIL PRESS. AT NOZZLE E.		NEW ENGLAND OIL BURNER CO.
	B				3			
	C				3			
		D	D		3		UP TO 10,000 SQ. FT.	
M15				1½ TO 2	3	HIGH OIL PRESS. AT NOZZLE E.	GRAV. SUPPLY OPTIONAL. BELT-DRIVEN OIL PUMP ON SMALL SIZES, DIRECT-DRIVEN ON LARGER SIZES. SPECIAL BUILT-IN COMBUSTION CHAMBER. CHOICE OF CONTROLS	NU-WAY CORP.
M25	M25			1½ TO 4	3			
	M35			3 TO 7	3			
		HP55	HP55	7 TO 19	3		HP55, 3000 TO 8000 SQ. FT.	
R	R	R			2	VER. ROT. G. AND E.		OIL AMERICAN BURNER CORP.
P	P	P	P		3	OIL PRESS. AT NOZZLE E.		OIL BURNERS DISTR. CO.
W				2½ MAX.	2	POT TYPE OIL & AIR MIX CHAMBER	W INDICATES "WHIRLFIRE" MODEL. GAS IGN.	
P	P			1½ TO 8	3	OIL PRESS. AT NOZZLE E.	2 SIZES TO 2800 SQ. FT.	PETROLEUM HEAT & POWER CO.
P1½	P1½			2 TO 5	3		TO 1750 SQ. FT.	
G	G	G		1½ TO 15	3		3 SIZES. TO 5000 SQ. FT.	
T				¾ TO 2	3	VER. ROT. G. OR E.	SUSPENSION FLAME TYPE, TO 700 SQ. FT.	
R	R			¾ TO 3	2		WALL WIPING TYPE, TO 1200 SQ. FT.	
W1½				¾ TO 3	3	HOR. ROT. CUP G.E.	MANUAL IGN., SEMI-AUTO. OIL PUMP OPTIONAL. UP TO 1000 SQ. FT.	
W	W	W	W	6 TO 60	6		ATOM. AVAILABLE WITH HIGH-LOW CONTROL. OIL PUMP OPT. 6 SIZES	
D	D	D	D	1½ TO 42	5		AIR TURBINE, ROT. CUP. 6 SIZES	
SUNRAY				2½ MAX.	1	VAPOR. IN A FIRE POT	HIGH-LOW OPERATION. GRAV. OR PUMP OIL HANDLING. OIL PILOT IGN.	PROGRESSIVE MACHINERY CO.
G5	G5			1½ TO 4	3	OIL PRESS. AT NOZZLE E.	SEVERAL MODELS, INCL. G5XX WITH SPECIAL CONTROLS	
	G6			1½ TO 5½	3		SERIES OF 4 MODELS TO 2500 ℔. DIFFER IN MOTOR AND CONTROLS	
		G8		5 TO 12	3	OIL PRESS. AT NOZZLE E.		
		G20	G20	23 MAX.	3		G20 IS HEAVY DUTY BURNER, G40 PRACTICALLY A DUPLEX MODEL OF 2 G20 MODELS ON ONE BASE	
			G40	46 MAX.	3			
MA				¼ TO 2	2	HOR. ROT. E.	1 SIZE: ALSO IN MODEL MM, 1 SIZE, MANUAL CONTROL UP TO #3 OIL ½-2½ G.P.H.	RAY BURNER CO.
AR	AR	AR		1 TO 15	3		4 SIZES. DUAL PUMP. SEE ALSO "OIL BURNING SYSTEMS." RAY TYPE AR.	
AG	AG	AG	AG	1 TO 33	2	HOR. ROT. G.E.	6 SIZES. GRAVITY TYPE. SEE ALSO "OIL BURNING SYSTEMS." RAY TYPE AG	
C					3	ATOM. PUMP TO PRESS. NOZZLE, E.	"COMPANION" MODEL. UP TO 400 SQ. FT. NET WITH CAST IRON BOILER	THE RAYFIELD MFG. CO.
JR	JR			2½ MAX.	3			
	1			4 MAX.	3			
	2			8 MAX.	3		FIRE DOOR DESIGN WITH NOZZLE DIRECTED DOWN TOWARD REFRACTORY BASE	
		2½		12 MAX.	3			
		3	3	15 MAX.	3			
G	G			7 MAX.	3	VER. ROT. E.	"GYRO" MODEL	
B1A				⅝ MAX.	2	VAPORIZING POT LOW PRESS. AIR. OIL PILOT	HIGH-LOW FLAME OPERATION. GRAV. OIL FLOW TO BURNER POT. EACH AVAILABLE IN DUPLEX MODELS WITH CAPACITY DOUBLED	REMINGTON-KEYSTONE MFG. CO.
B1B				1⅝ MAX.	2			
1B12	1B12			1½ TO 2½	3	OIL PRESS. AT NOZZLE G. OR E.	ALSO MODEL B6, 1½ G.P.H. MAX. #3 OIL	R-S PRODUCTS CORP.
1B20	1B20			2½ TO 4	3			
	1B30			4 TO 6	3			
	2B45	2B45		6 TO 10	3			
		2B70	2B70	10 TO 20	3		UP TO 7000 SQ. FT.	
CJ				1½ TO 3	3	OIL PRESS. AT NOZZLE LOW PRESS. AIR E.		SCOTT-NEWCOMB, INC.
C	C			1 TO 9	3			
	CA	CA	CA	7 TO 25	3		DUAL IGN. NOZZLES, AND CUT-OFF VALVES	

REFERENCE LIST—FACTORY-ASSEMBLED OIL BURNER UNITS

BURNER MODEL — FOR GROSS BOILER LOADS SHOWN BELOW (SEE UNDER "REMARKS")				FUEL		ATOMIZING AND IGNITION METHOD	REMARKS	MANUFACTURER
UP TO 1000 SQ. FT.	1000 TO 3000 SQ. FT.	3000 TO 6000 SQ. FT.	OVER 6000 SQ. FT.	RATE, GAL. PER HOUR, CATALOG LISTING.	NO., NOT HEAVIER THAN, (COM. STD. SPECS.)	ATOM. = ATOMIZING PRESS. = PRESSURE HOR. = HORIZONTAL VER. = VERTICAL ROT. = ROTARY ELECT. = ELECTRIC IGN. = IGNITION.	UNITS LISTED ARE FACTORY-ASSEMBLED, ATOMIZING BURNERS, WITH OIL PUMP AND FOR INTERMITTENT OPERATION UNDER AUTOMATIC CONTROL, UNLESS OTHERWISE NOTED. ALL ARE UNITS, I.E., COMPLETE AND READY FOR CONNECTION TO FUEL AND IGNITION SOURCE; HAVE SOME AUTOMATIC CONTROLS; INTENDED FOR CENTRAL HEATING—ISOLATED ROOM HEATERS AND RANGE BURNERS NOT LISTED. "SQ. FT." IN TABLE REFERS TO OUTPUT AT BOILER IN STEAM (240 B.T.U.) UNLESS NOTED AS "SQ. FT. NET."	TRADE NAME SAME AS COMPANY NAME UNLESS NOTED
S3B				¾ TO 1½	2	VER. ROT. G.OR E.	WALL-WIPING FLAME TYPES	SILENT GLOW OIL BURNER CORP.
S3A	S3A	S3A		1 TO 10	2			
1000	1000			1½ TO 3½	3	OIL PRESS. AT NOZZLE E.		
G	G	G		1½ TO 10	3			
106				1½ TO 2½	3	HOR. ROT. CUP G.		
108 & 208	108 & 208			1 TO 7	4			
	211 & 311	211 & 311	211 & 311	4 TO 25	5			
			114	15 TO 65	5			
PA8	PA8			8 MAX.	3	OIL PRESS. AT NOZZLE E.	MAKER ALSO HAS HOR. ROT. CUP UNIT, 5 SIZES, 2 TO 35 G.P.H., #5 OIL, MANUAL OR G.E. IGN., AUTOM. OR MANUAL OPERATION.	SIMPLEX OIL HEATING CORP.
	PA15	PA15		15 MAX.	3			
		PA30	PA30	30 MAX.	3		UP TO 12,000 SQ. FT.	
SP2				3 MAX.	3			
1165				1 TO 1½	4	OIL PRESS. AT NOZZLE E.	DISTINCTIVE ARRANGEMENT OF NOZZLES WHICH IS INSTALLED IN FIREDOOR AND DIRECTED DOWNWARD AT REFRACTORY BED	STANDARD ENGRG. WORKS
1765				1 TO 2½	4			
	1800S			4½ MAX.	4			
B				3 MAX.	3	OIL PRESS. AT NOZZLE E.		STEWART OIL BURNER CO.
D	D			10 MAX.	3			
		C		25 MAX.	3			
			1	40 MAX.	4		CONTINUOUS IGN.	
T	T			4 MAX.	3	LOW PRESS. AIR E.	DISTINCTIVE FEATURE ALL MODELS, FIRE DOOR INSTALLATION. PORTABLE UNIT WITH PORTABLE SUPPLY AVAILABLE. MODEL MM LIKE ME BUT HAS MANUAL IGN. MM AND ME, HIGH-LOW OPERATION	SUMMERHEAT CORP. OF AMERICA
S	S			4 MAX.	3	" " " G.		
ME	ME			5 MAX.	3	" " " E.		
11A	11A			1½ TO 6	3	OIL PRESS. AT NOZZLE E.	"SUNWAY" BURNER. UP TO 2500 SQ. FT.	SUNBEAM ENGRG. CORP.
A3U				1½ TO 2½	3	OIL PRESS. AT NOZZLE E.	UP TO 650 SQ. FT.	SUNDSTRAND SALES CO.
B5U	B5U			3 TO 4½	3		UP TO 1500 SQ. FT.	
	C6U	C6U		5 TO 10	3	OIL PRESS. AT NOZZLE G.E.	UP TO 4000 SQ. FT.	
SX				3 MAX.	3	VER. ROT. WITH ATOM. PUMP G.OR E.		SUPER OIL HEATOR SALES CO.
400	400			1½ TO 3½	3	HIGH OIL PRESS. AT NOZZLE E.		TAFT OIL BURNER CO.
3000	3000			2 TO 7	3			
C	C			8 MAX.	2	VER. ROT. E.	WALL-WIPING FLAME TYPE	TIMKEN-SILENT AUTOMATIC CO.
	BM	BM	BM	17 MAX.	3	VER. ROT. G.	UP TO 6500 SQ. FT. ALSO IN E. IGN. MODEL USES #2 OIL	
A	A			1½ TO 6	3	VER. ROT. G.OR E.	HOR. MOTOR GEARED TO VER. DRIVE SHAFT	U.S. BURNER CORP.
	B	B		3 TO 15	3		B TO 4000 SQ. FT.	
S4	S4	S4		1 TO 10		OIL PRESS. AT NOZZLE. LOW PRESS. AIR E.		WAYNE OIL BURNER CO.
			S5	5 TO 20				
			S6	10 TO 30				
K1200				¾ TO 3½	4	LOW OIL PRESS. AT NOZZLE G.OR G.E.		WILLIAMS OIL-O-MATIC HEATING CORP.
K1800	K1800			¾ TO 5	4			
J1200	J1200			2 TO 11	4			
	J1800	J1800		4 TO 17½	4			
	JJ	JJ		8 TO 24½	4			
K1				1½ TO 3	3	OIL PRESS. AT NOZZLE E.		WOOD HYDRAULIC HOIST & BODY CO.
K2	K2			2½ TO 5	3			
	K3			4 TO 8	3			
	K3500	K3500		7½ TO 15	3			
A				4 MAX.	3	OIL PRESS. AT NOZZLE E.	DISTINCTIVE BULLET-SHAPE; MOTOR, FAN & PUMP IN LINE	WOOLERY MACHINE CO.
	B	B		15 MAX.	3		B UP TO 4000 SQ. FT.	

supplying air. Most of the models listed are also listed by the Underwriters. An attempt was made to include only those so listed, but as the Underwriters' listings do not include catalog letters or numbers it is likely that entire agreement was not obtained. The material included at the top of the "Remarks" column also helps to keep clear just what classes of units are included in the present list.

Listing the model names and numbers in the four columns at the left under the boiler loads which they can supply is a unique feature. The model number or letter is written into as many of these columns as the model would reasonably be expected to be used with, in accordance with the rate of fuel consumption as given in the fifth column. Some leeway is possible in these listings and their use is illustrated later.

The four columns agree roughly with the boiler loads which can be kept in mind as classifying these burners by the common method of using the words domestic, commercial, and industrial. Use of this scale would set up as follows:

1st column..... up to 1000.....Domestic
2nd column..... 1000 to 3000..... Domestic-Commercial
3rd column..... 3000 to 6000..... Commercial
4th column..... above 6000..... Commercial-Industrial

The fuel number given in the sixth column is that of the heaviest oil recommended by the manufacturer for use with the model. It is believed that these numbers agree very closely with those of the Underwriters' lists, but the difficulty of checking was again encountered in this connection. The fuel oil number is that used in the Commercial Standard Specifications for Fuel Oil as fully outlined in the Handbook of Oil Burning (American Oil Burner Association, New York.) The following summary of these specifications is included for convenience.

No.	Name	App. Gravity Range — B°	Approx. Heat Content (B.t.u. per gal.)
1	Light Domestic	38–40	136,000
2	Medium Domestic	34–36	138,500
3	Heavy Domestic	28–32	141,000
4	Light Industrial	24–26	145,000
5	Medium Industrial	18–22	148,500
6	Heavy Industrial	14–16	152,000

The atomizing and ignition method used is indicated

in the briefest possible fashion in the seventh column. Enough is given to indicate the type used and to show whether the burner is vertical or horizontal and whether of "gun" or rotary type. Additional details regarding any particular model can be readily secured from the manufacturer. Further information on the general subject, including classifications and illustrations of types and characteristics, can be found in the clear and complete description in the Handbook of Oil Burning.

In using this list there are several points which should be clear.

The first of these is that the figures at the top of the first four columns (up to 1000, 1000 to 3000, 3000 to 6000, and over 6000) are in terms of gross load or output at the boiler nozzle in square feet of equivalent direct steam radiator. They should not be used as equivalent to heat losses or to the installed radiator without making a suitable allowance. Gross figures are used because it is common practice to list burner capacities in this way in the maker's catalogs. On the other hand, some makers list their capacities "net" or with the allowances made. This is indicated by the word "net" appearing in the column "Remarks." Check up on this point when using the list.

Because a model is listed under a certain column does not show that it extends through the whole range, and care must be exercised. Thus, if Model xy of the Blank Company is listed under "Up to 1000, 1000 to 3000, and 3000 to 6000," it does not follow that it is good for loads up to 6000. It would be listed this way if intended for loads only up to 4500, for this figure falls in the range of the 3000 to 6000 column. In cases where this occurs a note in the "Remarks" column indicates the maximum gross or net load which its maker recommends that it carry. Do not attempt to use the columns to prove that the given model is intended for loads up to the upper limit. In such cases consult the manufacturer for specific information and also check against the fuel consumption rate. Checking against the fuel column (column 5) will often answer such questions directly.

In this connection the following formula and data will prove valuable.

$$\text{Necessary Boiler Efficiency} = \frac{\text{Req'd Output at Boiler Nozzle (Sq. Ft. Steam Rad.) x 240}}{\text{Htg. Value of Oil per gal. x Max. Fuel Rate}}$$

Applying this formula will give a figure representing the efficiency of absorption which the boiler must reach if the burner, handling fuel steadily at its maximum rate, is to deliver enough steam to supply the necessary output. To judge how well the burner is capable of doing this it is necessary to set up a scale of what may be expected. This can be done as follows:

If Necessary Boiler Efficiency shown by formula falls between	*It indicates that capacity of burner to handle the job is:*
50 and 60%	Practically certain
60 and 70%	Reasonably good
70 and 80%	Possible with a good boiler and installation
80 and 90%	Should be checked up, and proved or guaranteed
90 and 100%	Very doubtful
100% and over	Impossible

This scale and formula applied against the data on size and maximum fuel rate shown in the list will permit forming a workable judgment as to the adequacy of the capacity of any given model and type to handle a job. Where burners under consideration fall near the border lines of reasonableness, or where they are to be installed under boilers whose capacity or construction is questionable, the manufacturer of both the boiler and the burner may well be consulted in order to add the weight of their opinions.

The question of least boiler and fuel capacity also comes up sometimes in finding the smallest job in which a burner of given maximum fuel-burning capacity should be installed. The list can be useful in this connection where the low limit of the fuel handling capacity is included in the fifth column. Where included, the figure can be used instead of the greatest fuel rate in the formula, and estimates of capacity at lowest oil-handling rate can be made in the same way as outlined for finding capacity at highest rate. Where the list gives only the maximum fuel-burning rate the least rate can be taken as one-half the maximum for estimating purposes. On burners for intermittent operation where the fuel-handling rate is changed by adjustments of nozzles or similar means, the smaller figure in the fifth column of the list is the fuel rate when the burner is set to handle the least amount of fuel.

The Oil-Burning Systems List and How to Use it

While the form of this list is similar to that used for factory-assembled units, it bases the load served on boiler horsepower instead of on square feet of radiator surface, lists the model number or letter under the head of method of atomizing and burner type, and uses the "Remarks" column to make the method of application clear.

The burners listed here correspond closely with the listing classification which the Underwriters describe as Oil-Burning Systems and Equipment, Industrial, in some of its publications. They are also sometimes described as "industrial burners," although burners of this kind are by no means limited to use under industrial boilers. In distinction to the lists of factory-assembled units, no attempt was made to check this list against the published lists of the Underwriters.

In a number of cases, figures for boiler horsepower were not supplied by the manufacturers, and in such cases an equivalence of three boiler horsepower per gallon of No. 6 oil was used. This assumes a boiler efficiency of about 70%. Because the figures used in the boiler horsepower column are thus approximate they should be used as a guide only, and accurate determinations of horsepower capacity should be based on the figures given in the third and fourth columns which are the fuel-burning rates.

Calculations of boiler horsepower capacity based on

REFERENCE LIST — OIL BURNING SYSTEMS

CAPACITY RANGE PER BURNER				ATOMIZING METHOD AND BURNER TYPE	REMARKS	MANUFACTURER
IN BOILER HP. (APPROX.)		IN GAL. FUEL PER HR.		MIX. = MIXING ATOM. = ATOMIZING PRESS. = PRESSURE HOR. = HORIZONTAL ROT. = ROTARY INT = INTERNAL EXT = EXTERNAL	INCLUDES THOSE COMPOSED OF A BURNER UNIT AND A REMOTELY LOCATED UNIT, OR UNITS, FOR SUPPLYING OIL OR AIR, OR BOTH. UNLESS NOTED, ALL ASSUME COMPETENT ATTENDANCE, MANUAL OR SEMI-AUTOMATIC OPERATION, HAND IGNITION, AND ABILITY TO USE OILS AS HEAVY AS NO. 6 WITHOUT PREHEATING	
FROM	TO	FROM	TO			
1½	6	½	2	TYPE P-AIR ATOM. EXT. MIX. USES ANY OIL AND AIR PRESSURES FROM ½ TO 125 LB.	A SMALL CAPACITY BURNER SPECIALLY ADAPTED TO LOW TEMPERATURE OVENS, SMALL INDUSTRIAL FURNACES AND BOILERS. CAN BE USED WITH GAS.	
1½	30	½	10	TYPE L-MECH. ATOM. EXT. MIX. TWO SIZES-1 WITH ¾" AIR LINE, 1 WITH 1½" AIR LINE. SMALLER USES EITHER HIGH PRESS. AIR OR HIGH PRESS. STEAM. LARGER USES AIR PRESS. 1 TO 4 LB.	CAPACITY RANGE, SMALL SIZE, ½ TO 1½ G.P.H., LARGE SIZE, 1 TO 10 G.P.H. LATTER SOMETIMES USED WITH AIR PRESS. AS LOW AS 8 OZ. ALSO TYPE LM, LIKE L EXCEPT HAS MIXER FOR USING GAS.	THE ANTHONY CO.
3	75	1	25	TYPE A-MECH. ATOM. EXT. MIX. AIR PRESS. 2 TO 12 OZ. OIL PRESS. 20 TO 125 LB.	MAX. CAPACITY DEPENDS ON OPERATING PRESS. TWO SIZES. TYPE D AND GH LIKE A BUT AVAILABLE IN LARGER SIZES. TYPE D FOR HANDLING PREHEATED AIR. GH FOR GAS ALSO. TYPE W WATER COOLED FOR USE WITH HIGHLY PREHEATED AIR.	
⅜	500	⅛	166	HIGH PRESS. FOR USE ON H.P. BOILERS. STEAM OR AIR ATOM. EXT. MIX. STEAM OR AIR 15 LB. OR OVER. OIL NOT OVER 10 LB. PER SQ. IN.	FLAME SHAPE FACTORY ADJUSTED TO FIT FIREBOX. OIL FEED CONTROLLED BY SPECIAL HAND REGULATING VALVE. 5 SIZES.	W.N. BEST CORP.
¾	60	¼	20	LOW PRESS. FOR USE ON L.P. BOILERS. AIR ATOM. EXT. MIX. AIR PRESS. 1½ LB. OIL PRESS. 6 LB. PER SQ. IN.	AIR SUPPLY THROUGH SEPARATELY-MOUNTED TURBO-COMPRESSOR, OR UNIT CONSISTING OF BLOWER, PUMP AND MOTOR ALL ON SAME SHAFT. BELT-DRIVEN UNIT ALSO AVAILABLE. 3 SIZES.	
28	675	9½	225	OIL PRESS. AT NOZZLE. 50 TO 200 LB. OIL PRESS.	SPECIAL DESIGNS OF FURNACE FRONTS FOR BOLTING TO BOILER. BURNERS SUITABLE FOR FORCED OR NATURAL DRAFT. HAND CONTROL OF AIR. FOR COMBUST. CAP'Y VARIED BY USE OF VARIOUS TIPS AND BY VARYING OIL PRESS. AT NOZZLE.	BETHLEHEM STEEL CO.
1½	3000	½	1000	STEAM. ATOM. INT. MIX. OIL PRESS. NOT OVER 50 LB. PER SQ. IN.	NATURAL OR FORCED DRAFT. AIR FOR COMBUST. ENTERS THROUGH DOUBLE ADJ. SHUTTER BUILT AROUND BURNER. HAND-CONTROLLED OIL FEED. BURNS #6 IF PREHEATED.	THE ENGINEER CO.
60	3000	20	1000	MECH. ATOM. OIL PRESS. AT NOZZLE	SAME SHUTTERS AS ABOVE. BURNS #6 IF PREHEATED.	
1½	120	½	40	TYPE 700. STEAM ATOM. INT. MIX.	SPECIAL ADJ. AIR REGISTER. BURNS #6 IF PREHEATED.	
3	600	3	200	HOR. ROT. WITH ATOM. CUP	5 MODELS. AVAILABLE IN A.C., D.C., OR STEAM-TURBINE DIRECT DRIVE, WITH OR WITHOUT PUMPS BUILT IN. MANUAL OR LOW PRESS. OR HIGH PRESS. AIR AND OIL CONTROL OPTIONAL ON MOST.	ENTERPRISE OIL BURNER CO.
				TYPE B. HOR. ROT. CUP.	SMALL BURNER, WITH SEPARATE PUMP UNIT OPTIONAL TO BUILT-IN PUMP. BURNS NOT HEAVIER THAN #3. SEE ALSO "FACTORY-ASSEMBLED LIST" UNDER S.T. JOHNSON CO.	
4	300	10 LB.	750 LB.	TYPE 28. HOR. ROT. CUP.	6 SIZES WITH AUXILIARY PUMP UNIT OR BY GRAVITY. MANUAL IGN. (SEE ALSO "FACTORY-ASSEMBLED LIST" UNDER S.T. JOHNSON CO.)	
1	100	½	35	AIR ATOM. INT. MIX. LOW AIR PRESS., 1 TO 5 LB.	MAX. CAPAC. ARE WITH 2½ LB. AIR PRESS. AND WITH HEAVY OIL. AVAILABLE IN 3 SIZES, ROUND OR FLAT FLAME, DEPENDING ON TIPS.	S.T. JOHNSON CO.
1	200	½	62	STEAM ATOM. INT. MIX. OIL PRESS. ½ TO 50 LB.	CAN BE USED AS AIR ATOM. BURNER. 5 SIZES, 2 SMALLEST FOR #3 OIL, LARGEST #6 OIL, BOILERS 20 TO 200 H.P. ADJ. FLAME CONTROLLED BY HAND OR SEMI-AUTOM. THROUGH BOILER STEAM PRESS. ROUND OR FLAT (FAN) FLAME DEPENDING ON TIPS.	
3	450	1	150	STEAM OR AIR ATOM. INT. MIX. AIR PRESS. 3 TO 25 LB. OIL PRESS. 5 TO 50 LB.	INSTALLATION CONSISTS OF BURNER, IGN. UNIT, AIR AND OIL PUMP UNIT. ROT. AIR COMPRESSOR, GEAR TYPE ROT. OIL PUMP, G. OR E. IGN. AUTOM. OR HIGH-LOW CONTROL. 4 SIZES.	LAMMERT & MANN CO.
				STEAM ATOM. INT. MIX. OIL PRESS. 30 LB. STEAM PRESS. 15 TO 40 LB.	INSTALLED IN ADJ. REGISTER FOR AIR CONTROL. MAY USE GRAVITY FEED OR SEPARATE PUMPING UNIT. HIGH-LOW CONTROL AVAILABLE. 5 SIZES.	
		4	40	TYPE IR. HOR. ROT. CUP. AIR TURBINE DRIVEN.	PUMP AND BLOWER UNIT REMOTELY LOCATED. AIR FROM TURBINE BECOMES ATOM. AIR. SECONDARY AIR ADMITTED THROUGH ADJ. SHUTTER CONCENTRIC TO BURNER NOZZLE. SEMI-AUTO (HIGH-LOW) THROUGH MECH. STEAM PRESS. CONTROL. MANUAL OPERATION OPTION.	NATIONAL AIROIL BURNER CO.
90	3500	BANKED FIRE	1000	MECH. ATOM. OIL PRESS. AT NOZZLE. PRESS. ABOUT 200 LB.	CIRCULAR DAMPER VANE AND DIFFUSER FOR AIR ADMISSION. NATURAL OR FORCED DRAFT. CAP'Y RANGE OBTAINED BY BY-PASSING SOME OIL INSTEAD OF BY CHANGING NOZZLES.	PEABODY ENGINEERING CORP.
90	3500	BANKED FIRE	1000	STEAM ATOM. INT. MIX. EXT. MIX. OPTION.	AIR OR GAS MAY BE USED INSTEAD OF STEAM FOR ATOM. USE SAME AIR REGISTER AS MECH. ATOM. TYPE.	
75	375	25	125	MODEL M. PRESS. ATOM. MECH. BURNER. OIL PRESS. 200 TO 250 LB. #6 OIL PREHEATED.	OIL SUPPLIED BY STEAM- OR MOTOR-DRIVEN PUMP AND SHUTTERS FOR AIR CONTROL. EITHER FORCED OR NATURAL DRAFT OPERATION WITH ONE STANDARD DESIGN. OPERATES ON SEMI-AUTOM. CONTROL BY BOILER STEAM PRESS.	
30 30	225 300	10 10	75 100	MODEL H } BOTH AIR TURBINE-DRIV- MODEL A } EN. HOR. ROT. CUP AND LOW PRESS. AIR AND OIL TYPES. #5 OIL WITHOUT, #6 WITH PREHEATING.	AIR FROM TURBINE BECOMES PRIMARY AIR. SECONDARY AIR THROUGH AN ADJ. REGISTER. DAMPER CONTROL ON SECONDARY AIR. FLAME SHAPE GOVERNED BY INTERCHANGEABLE TURBINE WHEELS. FAN AND PUMP SETS IN DUPLICATE. CAST ALUMINUM FAN DIRECT CONNECTED TO ELECTRIC MOTOR. PUMP WORM-DRIVEN FROM MOTOR SHAFT. 3 SIZES.	PETROLEUM HEAT & POWER CO.
20	188	7	60	MODEL W. MOTOR-DRIVEN HOR. ROT. ATOM. CUP. LOW PRESS. OIL. #5 OIL WITHOUT, #6 WITH PREHEATING.	OIL SUPPLIED BY SEPARATE OR INTEGRAL PUMP. PRIMARY AIR BY FAN INTEGRAL WITH BURNER, SECONDARY AIR BY NATURAL DRAFT THROUGH CONTROLLED DAMPER. SECONDARY AIR DISTRIBUTED THROUGH PORTS IN FURNACE FLOOR. COMPLETE MODULATED CONTROL OF ALL AIR AND OIL BY STEAM PRESS.	
20	1000	7	330	TYPE M. HOR. ROT.	DIRECT CONNECTED STEAM TURBINE-DRIVE. OIL BY GRAVITY OR THROUGH INDEPENDENT PUMP.	
3	255	1	85	TYPE AR. HOR. ROT. G.E. IGN.	9 SIZES. DUAL PUMP AND RESERVOIR. AUTOM. BURNS #5 OR #6 OIL WITH MAKER'S VISCOSITY SYSTEM. ALSO IN MODEL ARC, 6 SIZES, 1 TO 33 G.P.H. COMBINATION OIL AND GAS BURNERS.	
3	960	1	320	TYPE AG. HOR. ROT. MANUAL IGN.	13 SIZES, GRAVITY TYPE, SEMI-AUTOM. CONTROL. ALSO IN MODEL AGC, 9 SIZES, 1 TO 85 G.P.H., COMBINATION OIL AND GAS BURNERS, GRAVITY OR PUMP OPTIONAL. ALSO 6 SIZES, 1 TO 33 G.P.H., COMBINATION BURNERS WITH G.E. IGN.	RAY BURNER CO.
3	255	1	85	TYPE AP. HOR. ROT. MANUAL IGN.	9 SIZES, PUMP, SEMI-AUTOM. ALSO IN MODEL APC, COMBINATION OIL AND GAS BURNERS. LIKE AGC (SEE ABOVE)	
6	270	2	90	HOR. ROT. CUP. AIR TURBINE-DRIVEN	OIL, PRIMARY AND SECONDARY AIR UNDER SYNCHRONIZED CONTROL. TURBINE AIR BECOMES PRIMARY AIR. PRIMARY AIR AND OIL BY INDEPENT PUMP-BLOWER SET. SWING DAMPERS USED FOR SECONDARY AIR CONTROL. MAY BE ARRANGED FOR CONTINUOUS SET FLAME, HIGH-LOW OR INTERMITTENT FIRING. SEMI- OR FULL AUTOM. 2 SIZES BURNERS, 8 SIZES PUMP AND FAN SETS.	SIMPLEX OIL HEATING CORP.

REFERENCE LIST — OIL BURNING SYSTEMS

CAPACITY RANGE PER BURNER				ATOMIZING METHOD AND BURNER TYPE	REMARKS	MANUFACTURER
IN BOILER HP. (APPROX.)		IN GAL. FUEL PER HR.		MIX. = MIXING ATOM. = ATOMIZING PRESS. = PRESSURE HOR. = HORIZONTAL ROT. = ROTARY INT. = INTERNAL EXT. = EXTERNAL	INCLUDES THOSE COMPOSED OF A BURNER UNIT AND A REMOTELY LOCATED UNIT, OR UNITS, FOR SUPPLYING OIL OR AIR, OR BOTH. UNLESS NOTED, ALL ASSUME COMPETENT ATTENDANCE, MANUAL OR SEMI-AUTOMATIC OPERATION, HAND IGNITION, AND ABILITY TO USE OILS AS HEAVY AS NO. 6 WITHOUT PREHEATING	
FROM	TO	FROM	TO			
60	200			TYPE C, MECH. ATOM. OIL PRESS. AT NOZZLE. "WIDE RANGE," MECH. ATOM. NO TIP CHANGE.	EITHER NATURAL OR FORCED DRAFT. DISTINCTIVE TYPES OF AIR REGISTERS. THE 200 H.P. MAX. IS FOR NATURAL DRAFT. TYPE J SIMILAR TO C BUT SMALLER, MAX. CAPY AT 0.15 IN. WATER, 225 LB. PER HR. TYPE K, STILL SMALLER, 115 LB. PER HR. MAX. AT 0.15 IN. DRAFT.	SCHUTTE & KOERTING CO
65	200			"WIDE RANGE." STEAM OR AIR ATOM. EXT. & INT. MIX. OIL PRESS., 50 TO 75 LB. STEAM PRESS. EQUAL OR SLIGHTLY LESS THAN OIL PRESS. IF AIR ATOM., 10 LB. PRESS. FOR LIGHT OILS, 20 LB. FOR HEAVY OILS.	4 SIZES. USE DISTINCTIVE REGISTERS FOR ADMISSION AND CONTROL OF COMBUSTION AIR. BURNERS WITH CAPACITIES OVER 60 G.P.M. FOR SPECIAL WORK.	
		2	7	"FURNACE." STEAM OR AIR ATOM. EXT. MIX. OIL PRESS. 75 LB. AIR AT 10 LB. FOR LIGHT AND 20 LB. PRESS. FOR HEAVY OILS.	ONE SIZE.	
3	45	1	15	"MIDGET." STEAM OR AIR ATOM. INT. MIX. OIL AT 2 LB. PRESS. ABOVE THAT OF STEAM.	ONE SIZE	
25	100		30	"CYCLONE." ATOM. BY OIL PRESS. AND PRIMARY AIR. LIGHT AND HEATED HEAVY OILS AT 50 TO 150 LB. PRESS. LOW PRESS. AIR AT 4 IN. WATER FOR LIGHT AND 8 IN. FOR HEAVY OILS.	2 SIZES. PRIMARILY A FORCED DRAFT BURNER. USE DISTINCTIVE REGISTERS FOR ADMISSION AND CONTROL OF SECONDARY AIR	
20	165	6	50	"ASKO." AIR ATOM. INT. MIX. AIR PRESSURE 10 OZ.	GRAVITY OIL FEED ONLY, 10 FT. HEAD. FOR OILS ABOVE 20° BE." AND NO PREHEATING. 5 SIZES.	
		16 LB.	375 LB.	HOR. ROT. CUP, MOTOR-DRIVEN, FAN ON SAME SHAFT.	OIL PUMPED AT MODERATE PRESS. FROM REMOTELY-LOCATED PUMP. PRIMARY AIR ADJUSTABLE AT FAN INLET. SECONDARY AIR THROUGH DOOR ON BURNER.	TODD COMBUSTION EQUIPMENT, INC
		16 LB.	625 LB.	"SPIRO." HOR. ROT. CUP, LOW PRESS. TYPE. ATOM. COMBINATION OF LOW OIL PRESS. AND HIGH SPEED ROT. CUP.	AN AIR REGISTER AROUND BURNER NOZZLE ADMITS BURNER AIR. SYNCHRONIZED CONTROL OF OIL AND AIR. MANUAL, SEMI-, OR FULL AUTOM. CONTROL. MODEL WITH INTEGRAL PUMP ALSO AVAILABLE.	
		75 LB.	1200 LB.	STEAM ATOM. INT. MIX.	ONE SIZE NOZZLE, BUT TIPS OF VARYING SIZE PERMIT WIDE RANGE OF CAPACITY.	
				"WIDE RANGE." OIL PRESS. AT NOZZLE.	CAPY RANGE SECURED BY USE OF SPECIAL METHOD OF FEEDING OIL TO BURNER AT TWO PRESSURES—1 FOR MAX. AND A LOWER FOR MIN. OPERATION. 4 TYPES OF REGISTERS AVAILABLE. FOR STATIONARY PLANTS NATURAL, ASSISTED OR FORCED DRAFT.	

efficiencies other than 70 can be readily made to fit the particular case by use of the following equivalents:

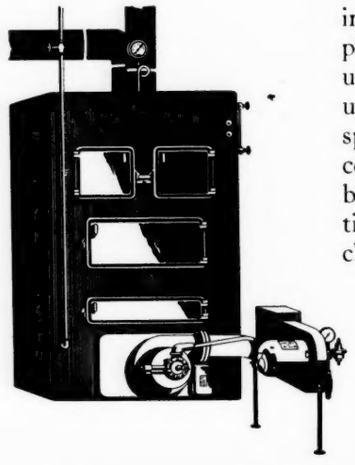
Efficiency %	Factor (boiler hp. per gal.)
60	2.7
70	3.1
80	3.6
90	4.1

In connection with the capacity columns it should also be noted that the figures are "per burner." As these burners are so adaptable for multiple installation this point should be clear, for multiple installation permits their serving boilers of horsepower greatly in excess of those shown.

This listing is of burners only, but in order to make operating installations auxiliaries such as a pump, a fan, and other items ordinarily must be installed. All the makers have suitable equipment for these purposes which when installed complete the oil-burning "system." Arrangement for installations involves considerable layout, planning, and other technical work, an important part of which is the adaptation of the combustion chamber for use with the burner.

In listing the atomizing method only enough is included to make the type of method used understandable. The Handbook of Oil Burning, previously referred to, contains an excellent classification of these methods and shows illustrations of typical burners, which are there referred to as industrial burners.

Operating control methods vary widely in plants using burners of this kind. Condensed information on the control usually employed is included in the Remarks column, but other control methods may usually be readily adapted to meet specific requirements. Semi-automatic control with an oil feed valve actuated by boiler pressure and with hand ignition is a much used combination on this class of equipment.



Boiler and Boiler-Burner Lists

From the earliest use of oil-burning devices under heating boilers the adaptation of the burner to meet the limitations of the boiler has been a problem. In the early installations, which necessarily had to be largely conversion jobs from coal-fired boiler equipment, there was little opportunity to do anything but meet these limitations as well as possible. As a result many ingenious methods were used and a considerable amount of information was accumulated with the result that installations of oil burners under existing heating boilers were well and speedily accomplished.

Gradually as oil burning came to be more generally used, the equipment was more and more installed at the time of original erection of all the heating apparatus. Thus, the burner was new and the boiler was also new, and both could be purchased to accommodate each other if suitable designs were available.

By this time the details of coal-designed boilers which made their conversion to oil firing difficult were well recognized, as were the generally desirable features which an oil-burning heating boiler should have.

Opinions were divided as to how best to proceed to get boilers having these suitable characteristics. As a result two lines of procedure were followed. One was to design boilers especially for oil burning, or else to redesign or adapt coal-using designs so that the desirable oil-burning features could be obtained while making it possible to still use them with coal if desired. The other method was to regard the boiler and burner as all one unit and to design the one to fit the other. The latter method is newer than the former and has come into growing prominence within the past few years. This distinction serves as the basis of division of the two present lists. The one we have called "Boilers for Oil Burning" and the other "Boilers-Burner Units." There is no agreed-upon or accepted method of naming, and this one serves the purpose.

List of Boilers (Without Burners) for Oil Burning and Its Use

Material for this list was collected through asking manufacturers if they made a boiler either especially for oil burning or which they treated as an oil-burning boiler in practice. The tabulation was arranged from their replies.

In view of the way in which oil-burning boilers have developed, and in view of the fact that most of them are made available by makers who have previously made coal-fired equipment, wide variations in practice would be expected. Some makers would find their coal-using designs suitable for oil burning with but minor changes, while others would be inclined to redesign completely, or to offer entirely new lines of boilers. Comparison of the boilers offered for oil burning with older products shows that this is a fact. The list thus includes boilers distinctly intended for oil burning only, others which closely resemble coal-fired boilers, and still others having intermediate characteristics. Their common factor is that they are all described currently as Oil-Burning Boilers. This condition is not a desirable one, but it nevertheless exists and must be accepted. It is mentioned in order that the basis of the listing may be clear and that notes made under the Remarks column may be better understood.

This list is intended to show what types and sizes of these boilers are now available. It is not intended, and does not contain enough data, for either comparative purposes or for boiler selection. Selection should properly depend on a great many factors in addition to those listed.

The list itself is simple and self-explanatory. Catalog listings of models are identified in the first column. The data in the second and third columns permit an understanding of the size job which can be accommodated and the number of sizes available from which a selection can be made. Enough construction data are given to identify the model as to boiler type and whether of cast iron or steel. The Remarks column of this list contains information which is intended to clarify details of construction, materials, and rating. These vary with each boiler model and are especially worth noting.

As is always the case with heating boilers, the question of ratings is both troublesome and confusing. No one method of rating has been generally accepted in spite of all attempts to secure agreement. The rating code adopted by the Steel Heating Boiler Institute has found notable acceptance among makers of steel heating boilers, and where catalog ratings are based on this code, the fact has been entered under the Remarks column. Where this note is not made opposite any model, the rating method can be determined only by consulting the catalog of the makers. Some use one code and some another; some rate at the boiler nozzle while others rate "net" with allowances for piping, pick-up, and other factors already made; still others rate for the use of oil and set the rating at a value different from that used if coal is the fuel. Because of the complex nature of the situation, it is impossible to make the method of rating understandable in the brief space of the Remarks column, and including it, might easily add to confusion instead of helping to eliminate it.

It can be stated definitely though that figures given in the second column of this list do not generally refer to the same base as those given in the first four columns of the list of Factory-Assembled Units. Do not try to tie the two lists together on the basis of listed size. Comparisons between models on the basis of the figures of the second column of this list are not valid because of the variety of methods used. The figures in the second column can be properly used to learn the approximate upper limit of size for preliminary purposes.

REFERENCE LIST—BOILERS (WITHOUT BURNERS) FOR OIL BURNING

SERIES OR MODEL	CAPACITY, LARGEST SIZE, IN SQ. FT. STEAM RADIATOR OR EQUIV., CATALOG LISTING	NO. OF SIZES	CONSTRUCTION C = CAST IRON S = STEEL W = WATER TUBE F = FIRE TUBE □ = RECTANGULAR O = ROUND H = HORIZONTAL, V = VERTICAL } FIRE TRAVEL	REMARKS SHBI INDICATES RATED ACCORDING TO STEEL HEATING BOILER INSTITUTE CODE. UNLESS OTHERWISE NOTED, BOILERS ARE BASICALLY DESIGNED FOR COAL, BUT ADAPTED FOR OIL BURNING	MANUFACTURER
IDEAL OIL #12	1400	4	C W H □	FOR OIL BURNING EXCLUSIVELY. GREEN JACKETED.	AMERICAN RADIATOR CO.
IDEAL WATER TUBE	23,320	41	C W H □	9 SIZES IN 23" GRATE TO 2185 SQ.FT. 8 SIZES IN 29" TO 3675. 8 SIZES IN 36" TO 5690. 7 SIZES IN 48" TO 15,270. 9 SIZES IN 79" TO 23,320.	
ARCO ROUND	1310	12	C W V O	RED JACKET.	
IDEAL REDFLASH	11,720	36	C W H □	RED JACKET. 7 SIZES IN 15½" GRATE TO 1150 SQ.FT. 8 SIZES IN 24¾" TO 2620. 7 SIZES, 32" TO 4680. 6 SIZES, 40" TO 6690. 8 SIZES, 48" TO 11,720.	
E	47,790	25	S W H	SHBI. BURNER TO BE INSTALLED IN REAR FIREBOX, GRATES IN FRONT FOR EMERGENCY FIRING OR INCINERATION	BASS FOUNDRY & MACHINE CO.
90	2100	3	S F V O	FOR USE WITH GUN-TYPE BURNER ONLY. DISTINCTIVE DESIGN, FOR OIL AND GAS ONLY. BLUE JACKET. COPPER TUBES.	
S	2380	9	C W V □	FOR OIL BURNING EXCLUSIVELY	BASTIAN-MORLEY CO.
K	6600	8	W V □	DISTINCTIVE DESIGN, COPPER TUBES, FOR OIL OR GAS BURNING ONLY. COMBUSTION SPACE CAN BE EXTENDED TO ACCOMODATE CERTAIN BURNERS.	BRYAN STEAM CORP.
SQUARE	17,520	39	C W H □	JACKET OPTIONAL	BURNHAM BOILER CORP.
ROUND	1250	12	C H O	" "	
BENTON	32,080	27	S F H	SHBI. TRIPLE-SERVICE, INCL. INCINERATION. BURNER TO BE SET IN REAR	COMBINATION BOILER CO.
COMBINATION	14,400	21	S W H	SHBI. SEE ABOVE.	
OIL 80	1513	8	S F H	SHBI. □ GREEN JACKET. SPECIAL DRAFT CONTROL. INSTANT HOT WATER HEATER. OIL BURNING EXCLUSIVELY.	FITZGIBBONS BOILER CO. INC.
ZU	45,934	25	S F H	SHBI. FOR OIL, GAS OR STOKER FIRING	
RZU, JR.	3893	11	S F H	SHBI. FEATURED FOR OIL FUEL OR STOKER FIRING. SPECIAL DRAFT CONTROL. INSTANT WATER HEATER.	
RZU P 500 FS FD	36,900	66	S F H	RZU-REAR SMOKE OUTLET. 20 SIZES TO 33,978 SQ.FT. P- H.P. RET. TUB., PORT FIREBOX. 8 SIZES TO 3150 SQ.FT. 500-RET. TUB., PORT FIREBOX. 14 SIZES TO 36,900 SQ.FT. FS- SMOKELESS, DOWN DRAFT, SINGLE PASS. 9 SIZES TO 7550 SQ.FT. FD- SMOKELESS, DOWNDRAFT, DOUBLE PASS. 15 SIZES TO 12,500 SQ.FT. ALL 5 TYPES SHBI	
A	2400	7	W V □	DISTINCTIVE DESIGN, COPPER TUBES, FOR OIL AND GAS	FORAN BOILER CO., INC.
M5	37,650	29	S F	SHBI. COMBINATION FIRE AND WATER TUBE.	THE FROST MFG. CO.
MAGIC	1230	4	S F V O	FOR OIL OR GAS BURNING ONLY. SHBI.	HEATING SYSTEMS MFG. CORP.
RESIDENCE	2230	10	S F H	SHBI	HEGGIE-SIMPLEX BOILER CO.
	41,290	30	S F H	SHBI	
3-WAY	15,000	22	S W H	2 COMBUSTION CHAMBERS, ONE FOR OIL, ONE FOR COAL. EITHER CAN BE USED BY OPENING OR SHUTTING DAMPERS. TRIPLE-SERVICE, INCL. INCINERATION.	JOHANSON BOILER SALES
RESIDENCE	1170	4	S W O	SHBI. TRIPLE-SERVICE. JACKET OPTIONAL.	JOHNSTON BROS., INC.
OIL	3500	7	S W □	FOR OIL BURNING EXCLUSIVELY. DISTINCTIVE ARRANGEMENT OF TUBULAR HEATING SURFACE. WATER HEATER BUILT IN	
ROUND	680	2	S F H O	FOR OIL OR GAS ESPECIALLY. RED JACKET. DISTINCTIVE DESIGN. SHBI.	KEWANEE BOILER CORP.
BRKST. FIREBOX	26,600	29	S F H	9 SIZES, DOWN DRAFT TO 9100 SQ.FT. 20 SIZES, UPDRAFT TO 26,600. SHBI.	
K PORT. FRBX	19190	29	S F H	9 " " " " 7220 " " 20 " " " 19,190. SHBI.	
SMKLS. PORT FRBX	44,700	36	S F H	18 " " " " 44,700 " " 18 " " " 40,480. SHBI.	
G	8653	19	S F H	FOR OIL, GAS OR STOKER FIRING. SHBI.	
WELD+RIVET	48,570	27	S F H	" " " " " " .SHBI. IN SMOKELESS OR UPDRAFT TYPES	
500	35,070	11	S F H	PORTABLE, UPDRAFT. SHBI.	
900	44,670	12	S F H	PORTABLE, DOWNDRAFT. SHBI.	
800	42,700	12	S F H	PORTABLE, UPDRAFT. SHBI.	
C	40,200	22	S F H	DIRECT DRAFT, PORTABLE, WELDED. SHBI.	
R	2380	8	S F H	RED JACKET. SHBI.	
PREMIER	42,500	38	S F H	SHBI	NATIONAL RADIATOR CORP.
ROUND	925	12	C W V O	RATING NET	
JACKETED	1680	14	C W H □	" "	
NOVUS	11,400	24	C W H □	" "	
IMPERIAL	8000	16	C W H □	" "	
SUPER SMKLSS	20,600	44	C W H □	" "	
LOW WAT. LINE	8000	21	C W H □	43" AND 47" WATER LINES. RATING NET.	
O & S	1200	3	S F V O	FOR OIL BURNING EXCLUSIVELY. RED OR GREEN JACKET.	ORR & SEMBOWER, INC.
KNOWLTON	13,160	16	S W H	" " " " .COPPER TUBES	
PACIFIC	38,890	38	S F H	SHBI.	PACIFIC STEEL BOILER CORP.
LOW WAT. LINE	54,470	36	S F H	SHBI. FOR OIL, GAS OR STOKER FIRING.	
RED CREST	2280	11	S F H	SHBI. RED JACKET.	
206 TO 212	1200	7	C W H □	FOR OIL BURNING EXCLUSIVELY. CREAM JACKET.	RICHMOND RADIATOR CO.
160 SPECIAL	860	6	C W H □	RATING NET, INCL. HOT WATER SUPPLY. JACKETED.	H.B. SMITH CO.
MILLS WAT. TUBE 240, 340, 440	10,200	28	C W H □	NOT JACKETED	
	40,000	14	S F H □	FOR OIL BURNING EXCLUSIVELY. COMBINATION FIRE AND WATER TUBE.	SPENCER HEATER CO.
RESIDENTIAL	800	1	S F V O	FOR OIL OR GAS ONLY. DOWNDRAFT. CONICAL FIREBOX. SHBI.	THE TITUSVILLE IRON WORKS CO.
HH	3060	12	S F H	WELDED, JACKETED OR UNJACKETED. SHBI.	
SR	45,660	24	S F H	WELDED. SHBI.	
RO	47,430	23	S F H	RIVETED. ALSO IN SERIES WO, WELDED. SHBI.	
XL	35,300	16	S F H	RIVETED, UPDRAFT. SHBI.	
0200 & 0270	11,100	19	C W H □	RATING NET	UNITED STATES RADIATOR CORP.
0400	7900	4	C W H □	" " .LOW WATER LINE.	
CAPIT'L ROUND	925	10	C W V O	" "	
RED TOP, A, B, C.	5805	23	C W H □	" " .JACKETED OR UNJACKETED.	
RO 3, 4	1250	4	C W H O	FOR OIL BURNING EXCLUSIVELY. JACKETED.	WEIL-MCLAIN CO.
JACKETED	3350	12	C W H □		
ROUND	1860	12	C W H O		
SQUARE	17,125	38	C W H □		

REFERENCE LIST—BOILER-BURNER UNITS

MODEL	BURNER DATA		BOILER DATA			REMARKS	MANUFACTURER
	ATOM.—ATOMIZING PRESS.—PRESSURE HOR.—HORIZONTAL ROT.—ROTARY E.—ELECTRIC IGNITION		CONSTRUCTION C =CAST IRON S =STEEL F =FIRE TUBE □ =RECTANGULAR O =ROUND W =WATER TUBE H =HORIZONTAL FIRE TRAVEL V =VERTICAL	NO. OF SIZES	CAPACITY, LARGEST SIZE, IN SQ. FT. STEAM RADIATOR OR EQUIV. CATALOG LISTING	INCLUDES ONLY UNITS AVAILABLE AS SINGLE ITEM CONTAINING POWER-DRIVEN BURNER, BOILER, CONTROLS AND ACCESSORIES, WHOLLY OR LARGELY FACTORY-ASSEMBLED, DELIVERED READY FOR CONNECTION TO FUEL, HEATING PIPING, AND POWER; USABLE WITH STEAM OR HOT WATER AND WITH SERVICE HOT WATER PROVIDED FOR, UNLESS NOTED	
	FUEL NO.	ATOMIZING METHOD					
K	2	VER. ROT.	C W V □	8	6600	BUILT-IN COMBUSTION CHAMBER. SMALL DIAMETER COPPER WATER TUBES, INSULATED AND METAL JACKETED	BRYAN STEAM CORP.
ARISTOCRAT	3	OIL PRESS. AT NOZZLE	S F V O	1	750	BUILT-IN REFRACTORY COMBUSTION CHAMBER STACK CONNECTION NEAR BOTTOM. BURNER SET ECCENTRIC TO GIVE GASES ROTATING MOTION. INSULATED AND METAL JACKETED.	COMBUSTION OIL BURNER CO.
5 10 15	3	OIL PRESS. AT NOZZLE.	S F H □	3	1500	CIRCULAR COMBUSTION CHAMBER, REFRACTORY LINED, OUTSIDE OF WHICH IS SECOND CYLINDRICAL SHELL CONTAINING FIRE TUBES. OUTSIDE THIS IS A THIRD CYLINDER CONTAINING WATER AND SET ECCENTRIC TO OTHER TWO. INSULATED AND METAL JACKETED. LONG FLUE GAS TRAVEL., LOW WATER LINE. INDUCED DRAFT FAN.	ELECTROL INCORPORATED
21LAI	3	IMPACT-EXPANSION	S W V ELLIPTICAL	1	1070	BURNER AND CONTROLS ON TOP OR UNDER STEEL HOOD. REFRACTORY-LINED COMBUSTION CHAMBER INSULATED, METAL JACKET. CONNECTION TO FLUE NEAR BOTTOM. HIGH PRESS. BLOWER.	GENERAL ELECTRIC CO.
U	4	LOW PRESS. AIR ATOM.	S F H O	7	5000	BLOWER FURNISHES ATOM. AIR AND FORCED DRAFT. CIRCULAR COMBUSTION CHAMBER, DOWNWARD GAS TRAVEL THROUGH LOWER FIRE TUBES, THEN UPWARD AND THROUGH UPPER TUBES TO STACK. FROM 750 TO 5000 SQ. FT. #4 OIL WHEN AUTOM.	GENERAL HEAT & POWER CO.
O	4	LOW PRESS. AIR ATOM.	S F H O		20,000	#4 OIL WHEN AUTOM., #5 OR 6 WHEN MANUAL. FROM 5000 TO 20,000 SQ. FT. ARRANGEMENT SAME AS "U."	
	3	OIL PRESS. AT NOZZLE	S F V O	8	5600	PRIMARILY A HIGH PRESS. UNIT, SAFE W.P. 100 LB. FIELD-APPLIED INSULATION. BUILT-IN COMBUSTION CHAMBER. WATER LEG BOILER. ALSO MODEL HE, TUBELESS, VERTICAL, WATER-LEG TYPE.	P.M. LATTNER MFG. CO.
T514 & TW14	3	VER. ROT.	C F V □	4	600	4 COLORS, INSULATED, METAL JACKET	PETROLEUM HEAT & POWER CO.
T53 & TW3	3	VER. ROT.	S W V □	2	1200	COPPER COIL WATER TUBES. 4 COLORS. INSULATED, METAL JACKET.	
90	3	OIL PRESS. AT NOZZLE. LOW PRESS. AIR	S F V O	3	2100	BOILER TUBES OF COPPER REFRACTORY-LINED COMBUSTION CHAMBER BUILT-IN. INSULATED, METAL JACKET. ENAMEL FINISH. SIZES, 700, 1300, 2100 SQ. FT.	WAYNE OIL BURNER CO.
CARTECO	4	LOW OIL PRESS. AT NOZZLE. E. OR G.E.	S F V O	5	1650	INSULATED, METAL JACKET. CAST IRON BASE. FIRE TUBES CONTAIN DEVICE FOR ROTATING FLUE GASES. SIZES, 420, 560, 850, 1200, 1650 SQ. FT.	WILLIAMS OIL-O-MATIC HEATING CORP.
5, 8, 12 & 16	3	OIL PRESS. AT NOZZLE	S W H AND V	4	1920	COMBUSTION CHAMBER ABOVE FLUES, STACK OUTLET NEAR BOTTOM. TUBES FLAT AND SHAPED TO PROMOTE HEAT TRANSFER. RATINGS NET.	WOOD HYDRAULIC HOIST & BODY CO.
500, 800 & 1200	3	OIL PRESS. AT NOZZLE. VER. E.	S F V O	3	1200	BOILERS OF FIREBOX STEEL, CHARCOAL IRON TUBES. SHIPPED ASSEMBLED. INSULATED, METAL JACKET. VARIETY OF COLORS. BUILT-IN COMBUSTION CHAMBER. SIZES, 500, 800, 1200 SQ. FT.	YORK OIL BURNER CO., INC.
4 H.P. & 6 H.P.	3	OIL PRESS. AT NOZZLE. VER. E.	S F V O	2	840	SAME AS ABOVE, EXCEPT RIVETED INSTEAD OF WELDED. 100 LB. W.P.	

List of Boiler-Burner Units and Its Use

The prime technical argument advanced in favor of the boiler-burner is that when this combination is designed as one unit, correlation of all the important factors of both the boiler and burner can be achieved at once. As these units are relatively new, little information is available as to how well this has been accomplished.

The present units do seem to follow along somewhat diverging lines in attempting to reach their objective. One kind of unit permits use of only one burner, while another can accommodate burners of either vertical rotary, or gun type. In some cases, too, the boiler designs are radically different from those used for coal firing, while in others they resemble them closely.

Because of the small number of these units now available, and because of their newness, the list does not differentiate between types. It is a listing of those about which requested information was supplied. In compiling the list, a combination of boiler and burner which appears on the market as a single catalog item was considered a boiler-burner unit, and is listed under the company name of its sponsor. The company under whose name it is marketed is not always the actual maker of both the boiler and the burner. In some cases arrangements have been made whereby boiler manufacturers make the boiler, and a burner manufacturer makes the burner.

The listing gives data similar to that supplied on the other lists for atomizing method used by the burner, and enough construction details to make clear the type and material of the boiler. The Remarks column should be noted carefully as it contains the differentiating notes. Capacities as listed in the sixth column are as shown in the catalog of the maker. In the main, the listing is in terms of output at the boiler nozzles although exact agreement has not been obtained and comparisons should not be undertaken without careful checking.

The units listed are mainly equipped with automatic controls and are for intermittent operation.

Summary

IN addition to and quite apart from the use of the charts as a guide to available equipment they can be analyzed and summarized to reveal a picture of the present equipment situation as a whole so far as the items with which they deal are concerned. Care must be exercised in the interpretations drawn, however, and some of the interesting items which can be found are presented here to illustrate how the charts can be used to advantage. Other points in addition to those noted here can evidently be found, for only the most obvious are taken up since lack of space does not permit a thorough analysis.

Factory-Assembled Burners

Take the first chart — that which lists Factory-Assembled units. Sixty company names appear on it and a total of 225 models are listed, an average of nearly four models per maker. We believe that the burners made by the companies listed account for at least 80% of all these burners produced yearly because nearly all the larger producers are included.

Suppose we want to know which of the several atomizing methods is most popular. A count shows that 12 companies have vertical rotary models, 10 have horizontal rotary models, and 44 offer pressure atomizing models. A peculiarity of the lists is that while most of the vertical rotary and horizontal rotary makers are listed, many companies making pressure atomizing burners are omitted. Even so, the list reveals clearly that the great majority of the makers have a pressure atomizing model.

Are the makers of these burners mainly specialists in one type or do most of them offer burners of all three types? The answer by count is that seven companies list nothing but vertical rotaries, three offer nothing but horizontal rotaries, and 34 have pressure type burners only. This shows a decided leaning toward specialization which is further emphasized by the fact that only two of the companies listed offer burners of all three types. Some offer burners of two types and the number can be easily found by count.

Then consider the matter of burner size. Examination of the list shows that the largest vertical rotary is listed at 20 gal. per hr. and the largest pressure burner listed calls for 40 gal. per hr., while the largest horizontal rotary is listed at 200 gal. per hr.

In regard to the grade of oil used, it is evident that at present the vertical rotary models show a predominance of No. 2 oil with No. 3 oil listed in a few cases only. Where No. 3 oil is used in these burners gas ignition is common. The pressure burners, however, nearly all list No. 3 oil with No. 4 in a few cases. The horizontal rotaries show a notable tendency toward No. 5 oil with automatic operation and No. 6 oil with manual ignition. Thus, the chart brings out the fact that the several burner types each has its typical fuel.

Counting the number of models and company names in each of the first four columns brings out several points of interest. No less than 40 models are listed in the column marked "Up to 1000 Sq. Ft." and whose upper limit places them entirely in this capacity group. That is, 40 models are for use purely and wholly in the smaller buildings. This is the largest single listing in any column where the burners do not break over into more than one column. It illustrates the tendency of many of the makers to offer a small burner for domestic installation regardless of their other lines. The total number of models listed in the "Up to 1000" column is 128. This is an average of over two models per company. The concentration of models in this group is very evident even at a casual glance. Here is where the majority of the units are sold and, parenthetically, where price competition is keenest. In the "1000 to 3000" column 124 units are listed by 55 of the 60 companies. Thus, nearly all the makers have a model in this size group and many have more than one. In the "3000 to 6000 Sq. Ft." group, 50 makers offer a total of 78 models. In the wide field above 6000 sq. ft. per burner, 30 companies list 45 models.

Oil-Burning Systems

The tendency toward specialization in type of burner is fairly marked, because the method and apparatus for handling the oil are worked up into a "system." Three companies confine their listing to horizontal rotary burners only, six list only pressure or steam (or air) atomizing burners and do not offer rotaries. A considerable number handle No. 6 oil without preheating.

Oil-Burning Boilers

The mere fact that 23 boiler manufacturers have a product for use with oil shows how widespread has become the practice of offering a special boiler for this purpose. Fourteen state that their product is especially designed for use with oil (or gas) only.

The question of the sizes in which these special designs are available can be answered by count from the chart. Fifteen models, or lines, are offered by the 14 makers of special designs. Of these, 10 are in such sizes that the largest is less than 2500 sq. ft., and all are metal-jacketed. Four of the 10 are cast iron, and six are of steel. The split between rectangular and round types is about equal.

Study of the chart also shows the very great number of sizes which are included in the lines of some makers. Many similar details can be found readily from the data included in the chart.

Boiler-Burner Lists

The 11 companies listed offer the majority—and probably the great majority—of these units now available on the market. With two exceptions each offers but one "line." The burners are predominantly of the pressure type, while steel is the boiler material in most models. Oil is No. 3 in most cases. The fact that most of these units are for small building use is apparent at a glance. A metal jacket over factory-placed insulation is practically standard, as would be expected.

The Growth of Oil Heating—An Editorial

OIL as a heating fuel has come into use so fast that many in the heating industry have never ceased to wonder at it. Probably fewer still have stopped to look over this development from a detached point of view. During the time when oil was making its greatest advances in number of installations it was not easy to get a detached point of view anyway. We were all too busy, for the years of greatest gains in the use of oil were years when the whole building industry passed through its boom. Beginning in 1926 the number of oil burners installed annually mounted rapidly until the peak year was reached in 1929. Since then the number of installations has fallen until 1932 saw about as many burners put in as 1927. In other words, the rise occurred during the period of general increase in building construction and which coincided with a period of high individual income. People had the means to purchase oil equipment and did so. As might be expected, the principal appeal was in residential heating, although its use in apartments and similar commercial buildings has increased steadily.

During these same years there was a steady fall in the unit price of fuel oil. This fall in price, which resulted from the discovery and development of more oil deposits than had been dreamed of, was perhaps as powerful a factor in the rise of oil burning as was the building boom itself. The fall in price did two things. First, it reduced operating cost which was a stumbling block in early years. Second, it did much to remove any fear of a rise in oil price, such as was freely predicted just before the discovery of the extensive oil deposits came along to confound the predictors. The drop in oil price is greater than often realized. Oil which formerly cost 9 cents to 10 cents per gallon at retail can now be had at from 5 cents to 6 cents. Prices of competing fuel have taken no comparable drop and oil steadily gained a relative price advantage.

Thus the use of oil has had the benefit of these two favorable breaks. Both have resulted from economic causes wholly beyond the control of any one connected with the manufacturing or installation phases of oil-burning. Combined, they undoubtedly constitute a considerable part of the several reasons why oil has come into such quick favor as a building heating fuel.

They do not explain all, though, by any means. The use of oil has not come about automatically and without effort on the part of the industry. Let there be no mistake about it, the oil group has itself piled up a series of solid achievements to supplement the breaks.

These achievements are really of two kinds—commercial and technical. As actually applied, both are so closely related that it is almost impossible to separate them.

Commercially the practices have been aggressive. Whole dealer and installation personnels have been recruited, trained and coordinated. Favorable factors have been ferreted out, stressed and actively promoted through carefully planned selling and advertising. Unfavorable and retarding forces have been fought and often overcome. Certainly much of the impressive record of sales and installations can be traced to the commercial practices used.

Technically, the progress has been great. No group in the heating industry has shown more zeal in learning of ways to advance its methods of doing things. None has been so willing to adopt and adapt discoveries or developments to its own purposes. None has shown more ingenuity in devices or apparatus. Many of what are now generally recognized as real advances in methods were first either welcomed by the oil group or actually developed by them or for their use. Among these are the increased use of thermostats and controls, thermionic tubes for relays and control, interlocking of operating and safety controls, and careful attention to secondary as well as to primary air. Apparatus includes new designs of electric motors, pumps, and safety fuel-feeding devices. It may well be said that compared to others in the industry the oil group has been willing to accept innovations and to go ahead while others merely debated.

An example of how this combination of technique and commercial practice has helped to solve a major problem is that of initial cost.

High initial cost was a critical problem in the early years. At present the initial cost of an oil-burning installation of the popular type is approximately half what it was 10 years ago. This decrease has done a good deal to assist in the rising popularity of oil fuel. True, part of the reduction can be traced directly to the general fall in the price level and part to the increasing tendency to sell on price which has been prevalent within the past two or three years, and cannot be credited to technique or good commercial methds. There still remain reductions which are directly traceable to improved technique and good commercial policy.

Among these are the reductions due to changes in regulations governing installation which have been progressively relaxed largely because of well applied and organized pressure on the part of the industry. Decreased factory costs made possible by increased production, improved production methods, simplification, and standardization of parts and assembly groups account for some, while lowered service charges made possible as increased operating reliability has been reached account for still more.

Organized effort has been effectively used in several directions and is a phase of the well conceived commercial policy practiced. The industry has worked as a group on securing uniform and favorable ordinances regulating installation and storage. It has aided in reforming abuses and irregularities in the oil supplied, and has cooperated in establishment of fuel standards.

Now the use of oil is well established, a considerable measure of public resistance has been overcome, acceptance is growing, and the industry stands as a well-integrated group proud of its accomplishments and alert to go ahead.

Facts About the Industry

Facts and figures on this and the next page have been collected from all available sources. They are arranged in tabular form for convenience. Enough important points are noted so that the highlights stand out. Information under each heading is the latest obtainable. Important among the sources in addition to our own surveys are Department of Commerce. Census Bureau, Bureau of Mines, Fuel Oil Journal, and others. All have been rounded for convenience.

INDUSTRY FIGURES

1. Number of small building burners operating, January 1933 850,000
   of which, mechanical draft burners totalled 700,000
   and, natural draft totalled 150,000
2. There are 160 known manufacturers of burners, and it is probable that the actual total is close to 200. Of these, many operate locally, and others are assemblers of parts. The 25 largest manufacturers produce at least 80% of the burners made.
3. Sales peak in 1929, with 130,000 burners for building heating.
4. In 1924, peak of production of natural draft burners was reached at 50,000, then fell off abruptly and gradually rose to 25,000 in 1931. In that year natural draft burners made up 1.5% of the factory value of domestic burners; mechanical draft accounted for 98.5%.
5. Geographical distribution of burners for building heating purposes is not uniform but is concentrated around certain metropolitan districts. New York and Illinois contain about half the installations made to date; Massachusetts and Pennsylvania account for another one-eighth. Thus, 60% of the oil-heating installations are in these four states. Commercial and industrial applications do not follow this distribution.

FACTORY-ASSEMBLED BURNERS

1. By all odds, the greatest number of these burners have always been, and still are, installed in existing burners, i.e. are conversion jobs. Provisions regulating installation have been revised and modified progressively in many cities.
2. During 1932, a total of 85,000 of these burner units were produced. Following items concerning them give highlights of present situation:
   a. 74,000 were mechanical draft and 11,000 natural draft.
   b. Retail prices declined about 10% during the year.
   c. Four out of five were in boilers; other one in warm-air furnaces.
   d. One in every six went into a new boiler; others were conversion jobs, mainly from coal.
   e. One out of every 11 replaced a worn-out burner whose average useful life had been from five to six years.
   f. Average retail installed price of a small residential job was about $350 (inside 275-gal. tank, burner and controls, no boiler). Lowest reported maintained price of such an installation was $175. The majority of residential jobs used inside tanks.
   g. Of the mechanical draft burners, one out of every 20 was a horizontal rotary; one out of four was a vertical rotary; and seven out of 10 were of the pressure atomizing type.
   h. The factory value was approximately $13,000,000 while the retail value of the completed installations approached $30,000,000.

HEATING COMMERCIAL BUILDINGS

Use of oil burners for heating commercial buildings may be summarized as follows:

1. Principal field has been small industrial buildings, apartment houses, stores, public buildings, with many miscellaneous.
2. Estimates of numbers of these burners operating are little more than guesses, with 40,000 considered a fair figure.
3. Operating cost is much more important consideration than when oil is used for domestic heating.
4. Distribution of these burners geographically is not similar to that of domestic burners. Pacific coast district contains many commercial installations.
5. Use of oil as a commercial heating fuel is increasing steadily, but accurate data covering recent years are not available.

OIL-BURNING SYSTEMS

1. Use of these burners for building heating is largely confined to high-pressure boilers where operating supervision is required.
2. Operating cost is a prime consideration.
3. Number of these burners operating in building heating plants is unknown.
4. For building heating, steam atomizing is little practiced, air or pressure atomizing are the commonly-used methods.
5. Provision of duplicate pumping equipment is good practice.
6. Factory costs of burners range from $10 to $250, exclusive of auxiliaries.
7. Installations require field engineering, and manufacturers are prepared to offer assistance.

BOILERS (WITHOUT BURNERS) FOR OIL BURNING

1. Boilers of a great range of size are available.
2. Small boilers are usually factory-assembled and are insulated and metal-jacketed, with small enough dimensions to permit passing through standard door openings.
3. Most small boilers are equipped with baffling or fire-protection refractories but not with fire-box refractories.
4. Large boilers resemble traditional coal-fired equipment in appearance and dimensions and are available riveted and welded, for high or low-pressure operation, and in all the boiler types.
5. Estimated number of installations in 1932 is from 12000 to 15000 boilers.

BOILER-BURNER UNITS

Following points are notable in connection with present situation of boiler-burner units:

1. Most have appeared in last five years; 1932 saw a number of new designs introduced.
2. Question of increased operating efficiency is not satisfactorily settled.
3. Improved appearance and single responsibility are chief sales points.
4. Designs are various; little agreement as yet as to form.
5. Most units are for domestic jobs and available only in small sizes; few high-pressure designs.
6. Estimated sales of these units in 1932 were upward of 8000.

Oil-Fired Central Boiler Plant Shows Savings for New Haven Municipal Buildings

Hall of Records, City of New Haven, Conn.

By WILLIAM W. GAYLORD†

IN 1929 the city of New Haven built a new Hall of Records as the first of a group of buildings to replace the old City Hall group. A new heating plant was installed in this building consisting of two boilers of 117 hp. rating with space provided for two additional boilers. It was expected that the new group would be heated from this plant.

Due to changes in conditions it is now probable that it will be some time before the old buildings are replaced. These old buildings were heated from two boilers located in the old City Hall by means of a steam main run through the basements of the various buildings and the tunnels connecting them. The buildings heated from this system were the Police Building, Old City Hall, City Hall Annex No. 1, City Hall Annex No. 2, and the Law Chambers building, the last being a building on city property but rented out.

Early in the winter of 1931-32, L. C. Smith, structural engineer in the building department, recognized the possibilities of savings to be made if the heating plants could be consolidated, and recommended to the director of public works, J. M. Golden, that an investigation be made to determine if this were possible. The investigation was authorized and the writer was called in as consultant to cooperate with Mr. Smith in making the investigation.

It was found that the heating load of the buildings supplied from the old plant was 22,300 sq. ft. of equivalent direct radiation and the load in the Hall of Records 18,300 sq. ft., a total of 40,600 sq. ft. as the maximum boiler load.

The boilers in the Hall of Records were equipped with a low grade fuel combustion system consisting of flat dumping grates and a forced draft fan connected to ducts entering the ashpits through an opening in the center of the bridge wall at the ashpit floor line. This system was especially designed for operation with buckwheat anthracite coal but specified to be capable of operating also with bituminous coal. The combined output of the two boilers at the maximum specified rate of burning the buckwheat coal was equivalent to 37,400 sq. ft. of radiation. It had been found difficult to operate the boilers at the maximum specified output due to the unfortunate arrangement of the forced draft sys-

†Consulting engineer, New Haven, Conn.

tem, and further investigation showed that it would be impracticable to burn bituminous coal with this equipment as it would cause much more smoke than could be tolerated.

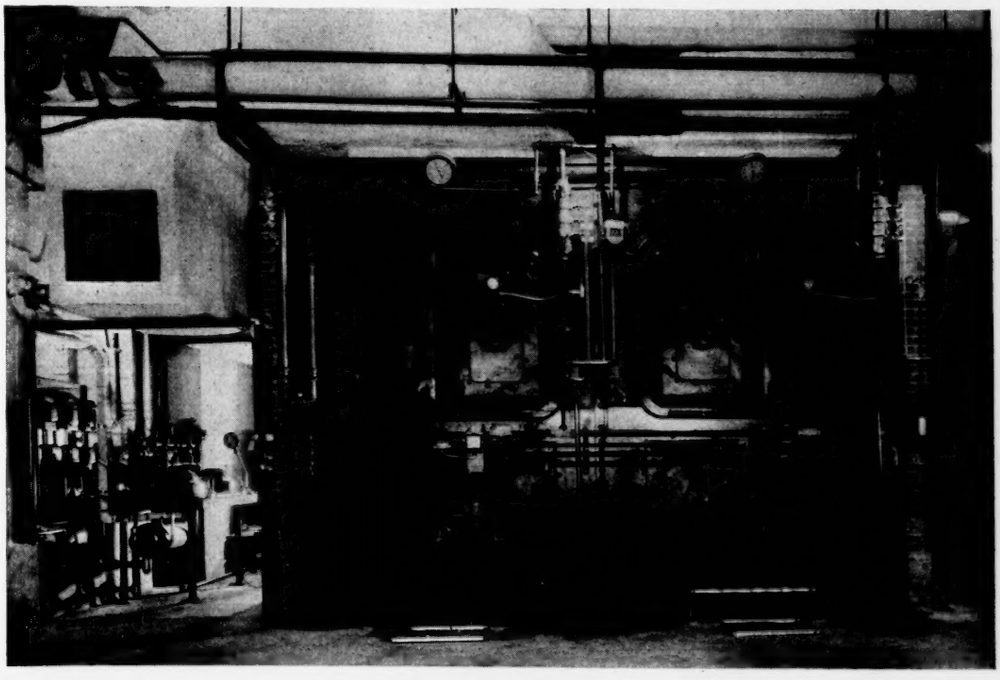
A complete study of the boilers, settings, and chimney showed that by the installation of suitable fuel-burning equipment these boilers could be economically operated at a continuous maximum output of about 48,000 sq. ft. of equivalent cast-iron radiation, more than sufficient to heat the whole group.

A complete study of the piping system in the old City Hall group showed that an 8-in. steam line could be run from the main steam header in the basement of the Hall of Records underground to the basement of Annex No. 2 and there connected to the main supplying the old group. This, with the installation of a new vacuum pump in the basement of the old City Hall, and a return line from this pump to the boilers in the Hall of Records would make it possible to heat all the buildings from the new boilers. A preliminary estimate showed that new fuel-burning equipment of sufficient capacity, the interconnecting piping, and a new vacuum return pump for the old group of buildings, could be installed for about $10,000. It further showed that by shutting down the boilers in the old group three less firemen would be required and material savings in fuel could be effected. Furthermore, the boiler plant in the old buildings required expensive repairs if it were to be kept in operation.

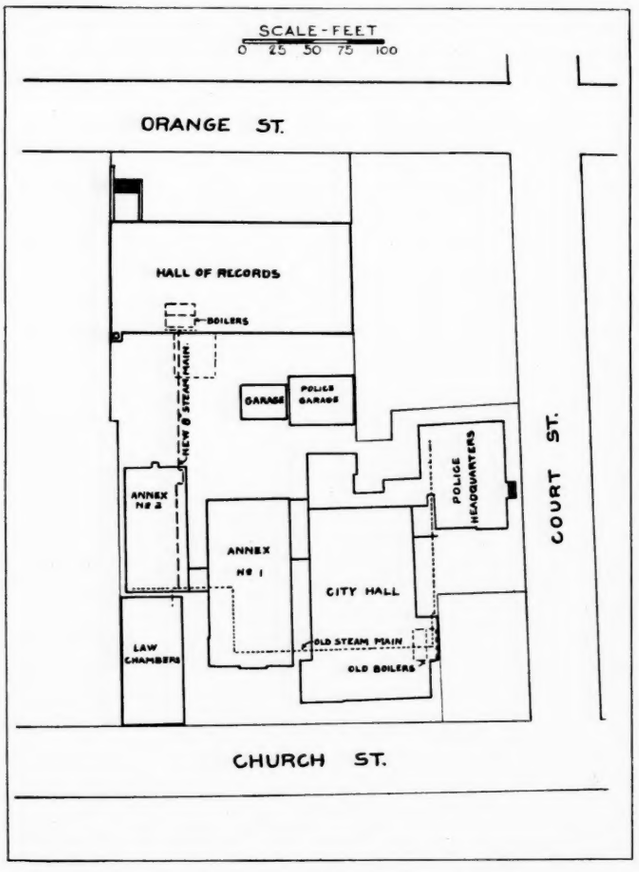
After careful consideration of all the factors involved, the director of public works recommended to the board of finance that the new fuel-burning equipment and the interconnecting piping be installed before the beginning of the heating season. The present administration, having taken over control of the city's affairs at a time when its finances were in a critical state, is practising the most rigid economy and any change calling for a capital expenditure must show an immediate return in reduced operating expense. Before authorizing this work the board of finance considered the proposition from every possible angle. The director of public works then instructed W. V. Barry of the City Engineering Department and Mr. Smith to have plans and specifications for the work prepared and issued for bids. The writer was retained as consultant to cooperate in carrying out this work.

To expedite the work it was decided to divide it into two contracts, the first to cover the interconnecting piping and new vacuum pump, and the second the installation of the fuel-burning equipment. Drawings and specifications for the interconnecting piping, the necessary changes to existing piping, and the installation of a new vacuum return pump and return line were made and issued for bids. While these were being figured an investigation to determine the most desirable fuel-burning equipment was made. This showed that because of the low setting height of the boilers and the fact that no pitting was possible (as the settings were built on a waterproof floor at the approximate permanent ground water level), stokers would be impracticable, but that oil burners for using Bunker C fuel oil could be installed to give a very satisfactory job with only minor changes to the existing settings. It was also found that a reliable supply of oil at a very attractive price was available. Specifications for the installation of oil-burning equipment, consisting of two semi-automatic horizontal rotary forced draft oil burners complete with necessary fuel oil tanks, auxiliaries, automatic controls, and changes to existing settings, were then made and issued for bids.

The bids when received showed that the whole installation could be made well within the estimated cost and contracts were awarded to the low bidders: The Buckingham-Routh Co., New Haven, Conn., for the installation of the interconnecting piping and new vacuum pump, and to the Enterprise Heating Service for the installation of oil-burning equipment and auxiliaries.



Oil-burning boilers which supply heat to the New Haven municipal buildings



Interconnection of heating systems, municipal buildings, New Haven, Conn.

Work was immediately started on the interconnecting piping, which consisted principally of an 8 in. steam line about 200 ft. long connecting the steam header in the new boiler room with the old steam main in the basement of Annex No. 2, and a 3 in. condensate return line about 500 ft. long from the new vacuum pump in the basement of the old City Hall to the new boiler. Both of these lines had to be carried underground for about 80 ft. between the basement of Annex No. 2 and the underground coal bunker at the new boiler room. This required the installation of a 20 in. sectional conduit which would carry both pipes. The 8 in. steam line was made up with welded joints and the expansion and contraction in this line was taken care of by bends made up with welding steel fittings. The diagram above shows the general outline of the system.

As soon as the oil burners were received work was started on changing one of the boiler settings for the use of oil, the other having been fired with coal to operate the heating system because of unexpected cold weather. The existing grates were removed and the fire and ashpit door frames removed from the boiler front plates. The top of the existing bridge wall was lowered to a point about 2 ft. 8 in. below the bottom of the boiler shell; new 9 in. walls of high grade refractory brick were laid up inside of the old bridge and side walls and the front wall rebuilt to suit the burner. A suitable checker work for the admission of secondary air was built over the front part of the furnace floor and the back part protected by a layer of insulating brick covered with a layer of firebrick.

The burners, which are horizontal rotary gravity type, are mounted on a ¼ in. steel plate which is top bolted to the old boiler front plate and of sufficient size to cover the openings for the old fire and ash doors.

Oil is supplied to the burners from a 10,000-gal. underground tank by an electric duplex pump set, through a thermostatically-controlled preheater. The burners operate on the high and low fire control system from a steam-pressure operated switch, and have all the automatic safety devices required by the Underwriters' rules. The photograph reproduced on page 31 shows the neat arrangement of burners, pumps, and piping. To allow for easy starting up of the burners after a protracted shut-down, an auxiliary tank of 275 gal. capacity for No. 3 furnace oil was provided and pipe connections made so that the burners could operate from this to generate steam to heat the Bunker C oil up to desired temperature before supplying it to the burners.

The burner and furnace of the first boiler were completed so that this boiler was put in operation November 13, 1932 to heat the Hall of Records, the interconnecting piping not having then been completed. It operated satisfactorily from the start but was found to have too large a capacity even at the lowest practicable fire for this one building in mild weather. About a week later the interconnecting piping was completed and the whole load put on the oil-fired boiler. It was found that a pressure of 5 lb. at the boiler gave satisfactory distribution of steam throughout the entire system and one boiler carried the load easily.

After the second oil burner was installed the entire system was operated from this boiler for a period of about two weeks and it was found to work as satisfactorily as the first. The entire load has been carried on one boiler up to the present time and for one period of 48 hr. the outside temperature averaged about 15°.

During the first week of operation the vacuum pump in the basement of the old City Hall stopped due to the burning out of a defective automatic float switch, and as this was not discovered for several hours, considerable trouble was caused by flooding the return mains. To guard against a possible recurrence of this trouble a second float switch has been installed which operates a signal bell in the boiler room and gives the fireman immediate notice of the stoppage of this pump.

The system is showing a satisfactory saving, as the following comparison with last year's operating costs shows. Last year, with the two coal-fired boiler plants in operation, the coal consumption was about 2¼ tons of buckwheat per day and 4 tons of soft coal per day. This year, with the entire load carried by one oil-fired boiler, the fuel consumption has been about 960 gal. per day. With oil at 3c per gal., buckwheat coal at $7.50 per ton, and soft coal at $5.25 per ton, this shows a daily saving of about $10.95 in fuel. In addition to the saving in fuel, three less firemen are required to operate the plant, so the estimated saving will be more than realized.

This is a good example of the improvement in service and savings in operating costs that can be made by an alert administration by carefully planned changes to existing plants at a small capital cost.

Government Hospital in Northwest Has Oil-Fired Boilers

Bebb & Gould, Architects *John Graham, Associate Architect* *Charles H. Knowles, Mechanical Equipment Engineer*

U. S. Marine Hospital, Seattle, Wash.

By CHARLES H. KNOWLES†

THE site of the new U. S. Marine Hospital, Seattle, comprises 10 acres located on the north slope of Beacon Hill, one mile southeast of the financial center of the city, donated to the United States Government by the City of Seattle.

In order to relieve acute unemployment in Seattle, the preparation of drawings and specifications was expedited as much as possible. The architects, Bebb & Gould, and John Graham, associate architect, were chosen in December, 1930; cabinet sketches were approved at Washington on January 5, 1931; final working drawings, including the mechanical and electrical, were completed two months later; bids for construction were opened in Washington, May 18; and the date for completion was set as November 15, 1932.

The completed buildings will cost $1,600,000 exclusive of equipment and furnishings. The hospital will provide accommodations for 320 beds and is so planned that all rooms have southern exposure. For the present the nurses will be accommodated in the main building, but later a nurses' home will be constructed on the site. In addition to the hospital and the attendants' building, three double residences and one single residence are built for the use of officials in charge of the institution.

†Mechanical Equipment Engineer, Seattle, Wash

Boiler Plant

The boiler room is located in the main building at about the center of the site. The other buildings are located higher up on the slope so that the condensation from them will return by gravity to the boiler room.

Steam for all purposes is generated at 100 lb. gauge pressure in three 150 lb. double pass, portable, smokeless steel boilers, each rated at 20,000 sq. ft. when burning oil. Boilers are set on brickwork 39 in. high from the floor to give a furnace volume of 320 cu. ft., equal to 1 cu. ft. for each 4½ sq. ft. of heating surface.

Each boiler is equipped with a feed water regulator and with an auxiliary hand-controlled boiler feed line. Boiler outlet connections are equipped with a 6 in. globe stop check valve and a globe stop valve with a free drain between the valves.

Steam Distribution

High pressure steam at boiler pressure is used to drive boiler feed pumps, turbine-driven vacuum pump and turbine-driven oil pump. Steam reduced to 90 lb. pressure is supplied to the laundry, while 60 lb. steam is run to the 6 ft. high pipe attic below the ninth (operating room) floor and distributed to the sterilizers.

Six sets of pressure reducing valves, each set consisting of two valves in parallel, with strainers and by-pass, are located in the pipe attic in a separate room lined with cork to absorb the sound of wire-drawing steam. These valves reduce the pressure of the steam from 60 lb. to 5 lb. for distribution to the five zones into which the direct radiation is divided, and to the separate steam main serving the operating suite ventilating system, radiation and blanket warmers.

In the boiler room steam is reduced from 60 lb. to 25 lb. for distribution to the hot water generator, kitchen, heating coils for the ventilating system, and to the underground steam main leading to the detached buildings.

Steam for the heating system is distributed by means of a vacuum return line system. Each of the six zones may be controlled by a graduated action pneumatic diaphragm valve located in the pipe attic with switches on the gauge board in the engineer's room.

Zone No. 1 feeds radiators on the north and east sides of the building; Zone No. 2, the west and south sides of the east seven-story wing; Zone No. 3, the east and south sides of the west seven-story wing; Zone No. 4, the north and west sides of the west seven-story wing, and Zone No. 5, the south side of the central portion of the building. The sixth division is that for the operating room suite.

Condensation from return risers for radiators, located above the pipe attic, is collected in horizontal return mains in the pipe attic and that from return risers from radiators located below the pipe attic is collected in return mains on basement ceiling. Vacuum returns are gathered together and carried to the vacuum pumps which discharge into a 36 in. × 72 in. surge tank with cold water makeup with float control.

High pressure returns are taken through a condensate cooler before going to the surge tank in order to avoid flashing to steam of high pressure drips in the vented surge tank, and this serves to preheat the cold water supply to the lower domestic hot water system. The boiler feed pumps handle the water from the surge tank to the boilers.

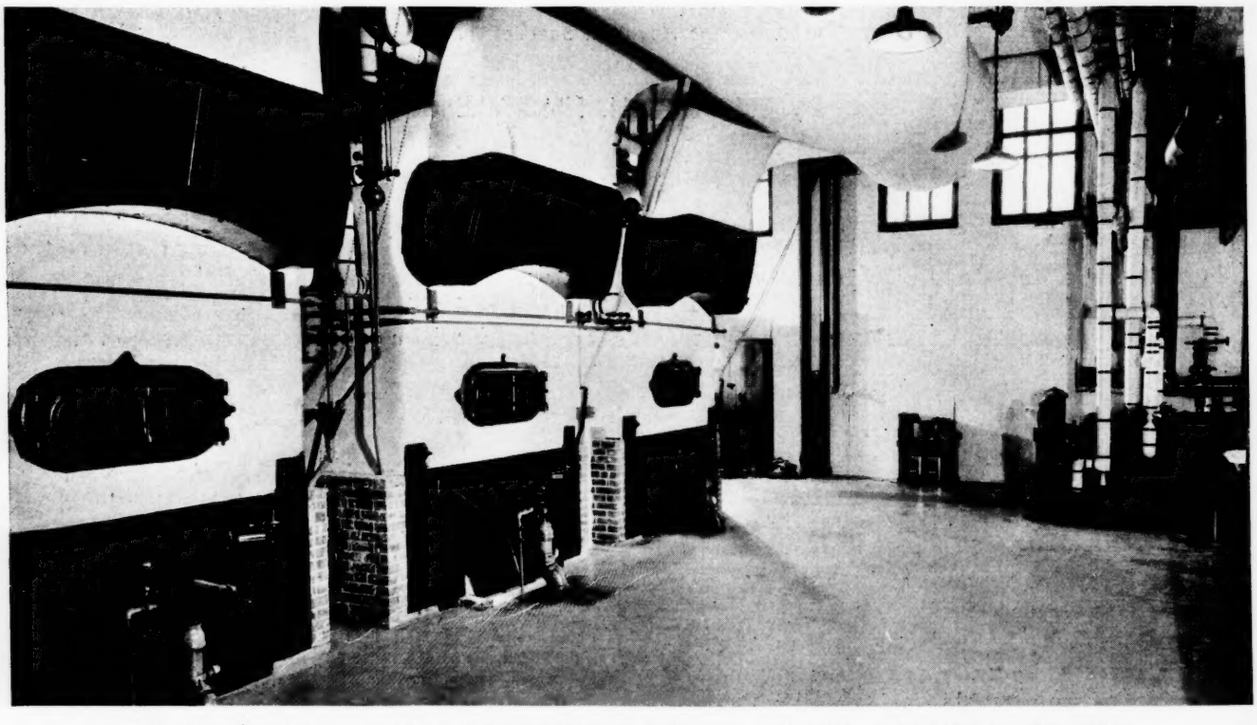
Heating Systems for Residences

Each single residence, each apartment in duplex residences, and the attendants' building, have complete individual closed hot water heating systems with their own separate converter.

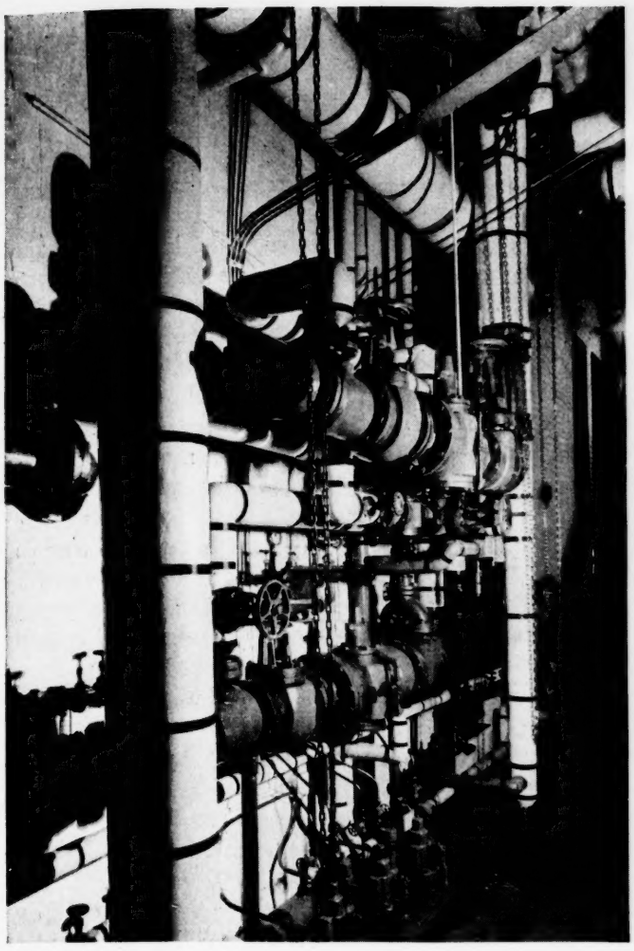
A 25 lb. steam main and a vacuum return main are carried underground from the main building to supply steam to, and remove condensate from, the converters of these hot water systems. Steam coils are provided in the domestic hot water storage heaters for each building.

Equipment

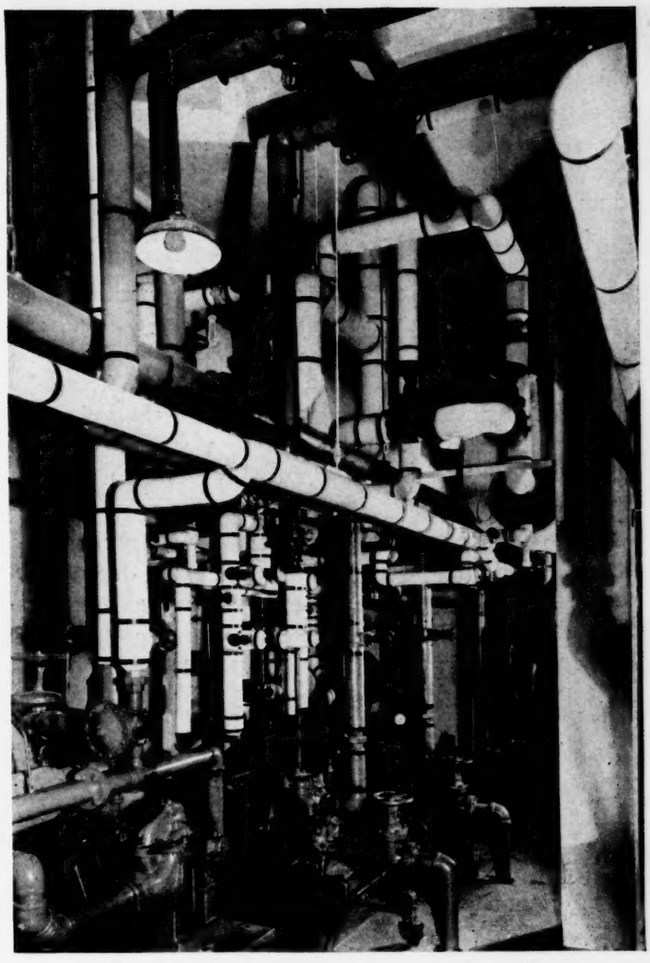
The steam and return mains are laid in standard 4 in. thick tin and asbestos-lined wood log pipe cover-



Boiler room showing breeching, oil burner blower and pump set, with ventilating fan for boiler room on platform above



Three high-pressure steam lines from the boilers, shown at the top, drop into the horizontal main header which connects into the vertical steam header at the left. From this are taken off the 60-lb. and 25-lb. pressure reducing valves



Turbine-driven vacuum pump and two duplex boiler feed pumps. Behind the column is the surge tank, above which is the hot water generator for the upper system

ing in a trench drained by a line of 4 in. unglazed agricultural tile and backfilled with gravel.

Mechanical traps are placed in the returns from heating sections, on hot water tanks, at drip points on high pressure lines, on returns from kitchen and laundry equipment, at sterilizers, etc. Thermostatic traps are installed on the return end of each steam radiator and wherever necessary to drain the low pressure system. Combination float and thermostatic traps are located at drip points of steam main, heating coils in hot water heating tanks, heater and reheater coils for ventilating systems, etc.

Most of the radiators throughout the buildings are tubular cast iron on wall hangers, hospital type, but a few copper concealed radiators are located at certain points. Radiators were selected in accordance with government ratings, which vary from those of manufacturers, requiring in most instances the installation of additional sections.

The two vacuum pumps have a capacity of 40,000 sq. ft. of radiation each when drawing 10 in. vacuum and discharging against 20 lb. pressure with dual control for operating on vacuum or water level. One is motor-driven and the other driven by a steam turbine operating with steam at 75 lb. pressure or above and exhausting into the 25 lb. steam line.

A recording, integrating, indicating electric steam flow meter, with manometer, 12 in., 24-hr. chart, rim planimeter, five-figure direct reading integrator, and synchronous electric clock, measures the steam flow from each boiler.

Two oil meters are provided, one for measuring the oil in the line leading to the burners and one for recording the oil returned to the oil storage tanks. A cold water meter is installed in the cold water supply to each hot water generator. A vacuum type condensate meter having a capacity of 8000 lb. per hr. and capable of metering water at 200° under a vacuum of from 6 in. to 10 in. is used in the suction line to the vacuum pumps.

On the front of each boiler is a draft gauge of the differential inclined tube type with suitable gradations for measuring the draft in the combustion chamber of each boiler.

In the engineer's room the black ebony asbestos gauge board has mounted on it 10 pressure and compound gauges for indicating pressures or vacuums in steam, water and compressed air systems, an eight-day clock, six pneumatic switches, two oil depth gauges, and three manometers and recording charts for the steam flow meters.

Incinerator

An incinerator 10 ft. long, 5 ft. wide and 7 ft. high, capable of burning 200 lb. per hr. of waste materials, consisting of 65% garbage and 35% rubbish (by weight), without the emission of fumes or objectionable odors, is located in the boiler room. This incinerator has a set of self-stoking grates and ash grates, so arranged that the material deposited in the incinerator rests on the self-stoking grates and does not interfere with the passage of air through the grates. The ash grates are located at the rear and below the self-stoking grates in a position to receive the ash from the self-stoking grates. The charging door is of the guillotine type, counterweighted. There are two gas burners, each with a capacity of 100 cu. ft. per hr., in the incinerator.

One air turbine-driven oil burner tip is provided for each boiler, and one motor-driven and one steam turbine-driven blower and pump set serve all the boilers. These Petro burners are of sufficient capacity to burn enough No. 6 oil, containing approximately 18,500 B.t.u. per lb., to develop 175% of the normal rating of each boiler. Steam preheaters are provided in the oil lines adjacent to the boilers.

The oil burners are provided with devices to (a) regulate the quantity of oil and air, both primary and secondary, to the burners so as to maintain, practically constant, the desired steam pressure; (b) shut off the main oil supply in case of electric current failure or low water; (c) shut off the main oil supply from pumps in case of drop in pressure in oil supply line to burners below a predetermined minimum pressure; (d) ring an 8-in. electrically-operated gong in boiler room upon failure of oil supply to burners or low water or failure of electric current.

The two buried steel oil storage tanks are 6 ft. in diameter and 30 ft. long, equipped with manholes and steam heating coils.

Ventilation

In general, the hospital is not artificially ventilated. In the wards, offices, etc., the windows are equipped with window ventilators. The only areas supplied with forced ventilation fresh air are the operating suite on the ninth floor and the kitchens and dining rooms on the ground floor. The former is taken care of by a 5300 c.f.m. outfit comprising fan, air washer, filter, heating coils, pneumatic automatic temperature and humidity control, etc., and the latter by a similar outfit with a capacity of 19,000 c.f.m. The other 11 fans are all exhaust fans ranging in size from the main kitchen exhaust, 19,000 c.f.m., and the general exhaust, 17,000 c.f.m., down to the little recreation room exhaust, 2,900 c.f.m.

All of the fans except one are driven by 1200 r.p.m. constant speed 208-volt, 60-cycle, 3-phase squirrel cage motors with V-belt drives and magnet switch and push-button controls. The exception is the kitchen and dining room fresh air fan which has a variable speed slip ring motor. All motors have momentary contact push buttons equipped with pilot lights located in the engineer's room, as well as push buttons adjacent to motors.

Motors for the operating room fresh air and exhaust fans have an additional push button and pilot light located in the scrub-up room on the ninth floor. This push-button control is so arranged that the operation of this single push button will put into operation or stop all of the ventilating apparatus for the operating suite, including opening the steam valves, followed by starting the fan and air washer pump and opening the fresh air dampers. The starting of the fan and opening of the fresh air damper is delayed until after the temperature of the air ahead of the air washer shall have reached at least 40°.

The motor for the main kitchen exhaust fan has an additional push button and pilot light located in the dietitian's office, and the motor for the laundry exhaust fan has an additional push button and pilot light located in the laundry.

Each fresh air intake leading to a fan and each discharge from an exhaust fan is equipped with a damper arranged for pneumatic control, so that the damper will be open when the fan is running and closed when the fan is stopped. The electrical controls for the fans are so interconnected with the pneumatic control system that no attention to the dampers on the part of the operator is required when starting and stopping the fans.

Fans have double-curved blades, with horsepower curves having self-limiting characteristics. Tip speeds of fans have been restricted to 5000 f.p.m., or less, and outlet velocities at the point of cut-off to not more than 1500 f.p.m.

An interesting feature of the automatic humidity control is that it is used to prevent trouble frequently encountered in operating rooms from explosions of ether due to sparks from static electricity. Control for the operating suite apparatus is set to maintain a dew point of 62° at the discharge end of the washer. This gives a relative humidity of 65% at a room temperature of 75°, which is so high that no danger from static electricity, and consequent explosions, exists.

List of Equipment

Boilers—Kewanee Boiler Corporation.
Check valves—McAlear Manufacturing Company.
Compound pressure gauges—Jas. P. Marsh Corporation.
Condensate meter—American District Steam Company.
Controls—Powers Regulator Company.
Filter—Independent Air Filter Company.
Hot water converter and storage heater—The Sims Company.
Oil burners—Petroleum Heat & Power Company.
Pipe—National Tube Company.
Pneumatic diaphragm valves, zoning—Powers Regulator Company.
Pressure reducing valves—Kieley & Mueller, Incorporated.
Radiators, cast iron—American Radiator Company.
Radiators, copper—Rome Radiation Company.
Refrigeration—York Ice Machinery Corporation.
Sheet metal for ducts—American Sheet and Tin Plate Company.
Traps—Jas. P. Marsh Corporation.
V-Belts—Allis-Chalmers Manufacturing Company.

Estimating Oil Requirements

THE accompanying nomographic charts, designed by Burton E. Shaw,† are for determining oil consumption in heating systems and for determining the amount of oil equivalent to a ton of coal under various conditions.

Fig. 1 can be used to determine the average oil requirements of steam, hot water or warm-air heating systems. In the case of the latter, inasmuch as the square inches of leader pipe carries more heat to upper floors than to the first floor, each floor must be figured separately.

To use Fig. 1 determine the average number of degree days per heating season in your locality (this figure for a list of 80 cities is given in Table 1) and mark off on line A. On C determine the square feet of radiation or the square inches of leader pipe area. Connect the points on A and C with a straight line and mark the intersection on B. Then draw a straight line from this intersection to the proper point on G and mark the intersection on D. Connect this intersection with a straight line to the efficiency of the system on F, and where this line crosses E, find the gallons of oil per season.

Example: How much oil will be required for a system having 1000 sq. ft. of steam radiators in a city where the number of degree days per season is 3000 and the system operates at a seasonal efficiency of 60%?

Solution: Connect the point at 3000 on A with the 1000 point on C. From the intersection of this line with B draw a straight line to the mark indicating "steam" on G. From the intersection of this line on D draw a line to the point 60 on F. This line intersects E at about 3300, which is the number of gallons of oil which will be required.

It is important to note that the chart does not take into account the variation in heating value of the different grades of oil, but is based on an average oil, and it is not designed for use in localities where the radiators or leader pipe were designed for temperatures other than zero to 70.

†Consulting mechanical engineer, Southwick, Mass.

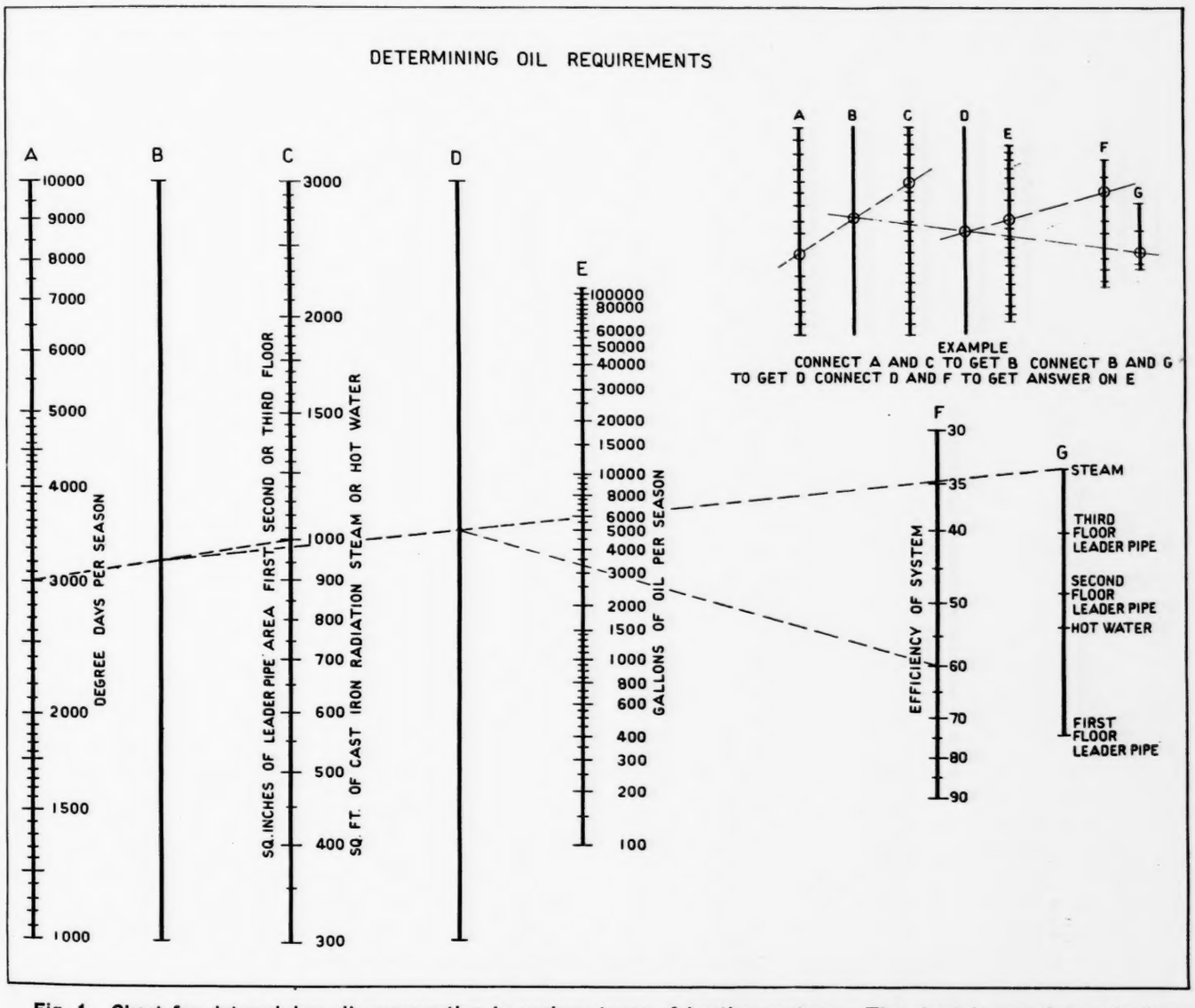

DETERMINING OIL REQUIREMENTS
A
B
C
D
E
F
G
DEGREE DAYS PER SEASON
SQ. INCHES OF LEADER PIPE AREA FIRST SECOND OR THIRD FLOOR
SQ. FT. OF CAST IRON RADIATION STEAM OR HOT WATER
GALLONS OF OIL PER SEASON
EFFICIENCY OF SYSTEM
STEAM
THIRD FLOOR LEADER PIPE
SECOND FLOOR LEADER PIPE
HOT WATER
FIRST FLOOR LEADER PIPE
EXAMPLE
CONNECT A AND C TO GET B CONNECT B AND G TO GET D CONNECT D AND F TO GET ANSWER ON E

Fig. 1. Chart for determining oil consumption in various types of heating systems. The chart is complete only for northern climates where radiation is designed for zero outside temperatures. For cities where other design temperatures prevail, correct the figure obtained from this chart as explained in the article.

Average Number of Degree Days per Heating Season for Various Cities

Akron, Ohio	6069	Concord, N. H.	6852	Little Rock, Ark.	2811	Richmond, Va.	3725
Albany, N. Y.	6889	Davenport, Iowa	6287	Los Angeles, Calif.	1504	Salt Lake City, Utah	5553
Asheville, N. C.	4263	Denver, Colo.	5873	Louisville, Ky.	4180	San Diego, Calif.	1645
Atlanta, Ga.	2891	Des Moines, Iowa	6373	Madison, Wis.	7395	San Francisco, Calif.	3264
Atlantic City, N. J.	5175	Detroit, Mich.	6494	Memphis, Tenn.	2950	Savannah, Ga.	1490
Baltimore, Md.	4533	Dodge City, Kan.	5034	Milwaukee, Wis.	7372	Scranton, Pa.	6129
Bethlehem, Pa.	5238	Duluth, Minn.	9480	Minneapolis, Minn.	7851	Seattle, Wash.	4968
Birmingham, Ala.	2408	Elmira, N. Y.	6414	New Haven, Conn.	5895	South Bend, Ind.	6076
Bloomington, Ill.	5793	El Paso, Tex.	2428	New Orleans, La.	1023	St. Louis, Mo.	4585
Boise, Idaho	4558	Erie, Pa.	6266	New York, N. Y.	5348	St. Paul, Minn.	7925
Boston, Mass.	6045	Fort Wayne, Ind.	5916	Norfolk, Va.	3349	Syracuse, N. Y.	6592
Buffalo, N. Y.	6821	Galveston, Tex.	1016	Oklahoma City, Okla.	3613	Tacoma, Wash.	5180
Burlington, Vt.	7620	Greensboro, N. C.	3527	Omaha, Neb.	6128	Terre Haute, Ind.	4871
Butte, Mont.	8271	Harrisburg, Pa.	5476	Paterson, N. J.	5369	Toledo, Ohio	6103
Charleston, S. C.	1769	Hartford, Conn.	6037	Philadelphia, Pa.	4855	Topeka, Kan.	5301
Cheyenne, Wyo.	6979	Indianapolis, Ind.	5297	Pittsburgh, Pa.	5235	Tucson, Ariz.	1845
Chicago, Ill.	6315	Jacksonville, Fla.	890	Portland, Me.	7012	Vicksburg, Miss.	1822
Cincinnati, Ohio	4702	Jersey City, N. J.	5192	Portland, Ore.	4468	Wheeling, W. Va.	5249
Cleveland, Ohio	6174	Kalamazoo, Mich.	6252	Providence, R. I.	6014	Wichita, Kan.	4877
Columbus, Ohio	5323	Kansas City, Mo.	5302	Reno, Nev.	5891	Wilmington, Del.	4788

It is applicable for average installations in many northern climates, but cannot be used without correction for more southerly locations.

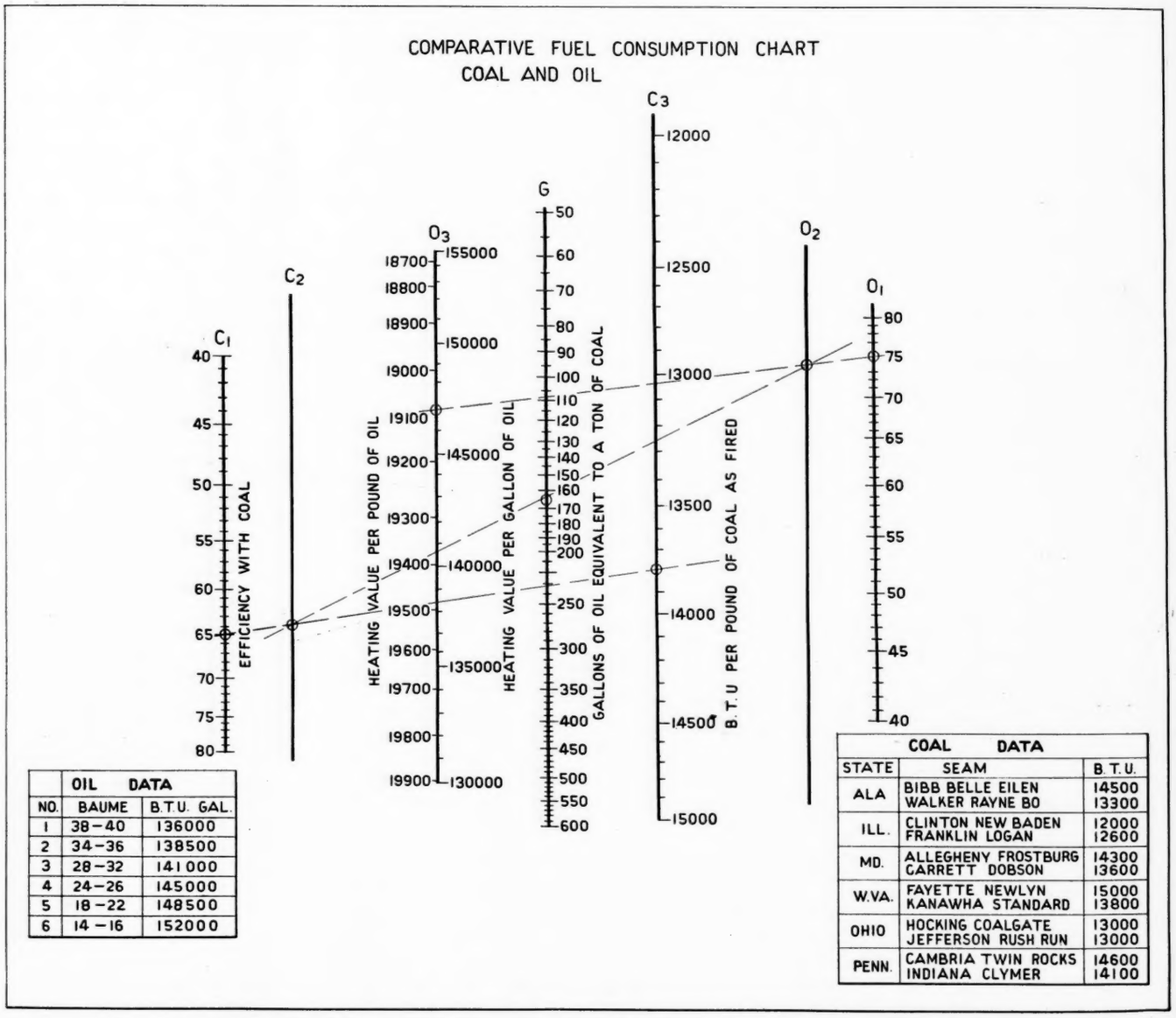
To correct for design temperatures other than zero, multiply the number of gallons obtained on E by

$$\frac{70°}{70° - \text{outside temperature designed for}}$$

For example, if, in the case cited above, the radiators had been designed to maintain 70° in 10° weather, our fraction would be

$$\frac{7}{6} \text{ and } \frac{7}{6} \times 3300 = 3850.$$

Fig. 2 is best described by giving an example. A



	OIL DATA	
NO.	BAUME	B.T.U. GAL.
1	38–40	136000
2	34–36	138500
3	28–32	141000
4	24–26	145000
5	18–22	148500
6	14–16	152000

COAL DATA		
STATE	SEAM	B.T.U.
ALA	BIBB BELLE EILEN	14500
	WALKER RAYNE BO	13300
ILL.	CLINTON NEW BADEN	12000
	FRANKLIN LOGAN	12600
MD.	ALLEGHENY FROSTBURG	14300
	GARRETT DOBSON	13600
W.VA.	FAYETTE NEWLYN	15000
	KANAWHA STANDARD	13800
OHIO	HOCKING COALGATE	13000
	JEFFERSON RUSH RUN	13000
PENN.	CAMBRIA TWIN ROCKS	14600
	INDIANA CLYMER	14100

Fig. 2. Chart for determining the number of gallons of oil equivalent to a ton of coal.

coal-fired system operating at a 65% efficiency when burning coal with a heat value of 13,800 B.t.u. per lb. as fired. What will be the equivalent gallons of oil to a ton of such coal if the oil burner system burns 147,000 B.t.u. per gal. fuel at an efficiency of 75%?

Solution: On scale C locate the efficiency when burning coal, 65%, and connect this with a straight line to the point 13,800 on scale C_3. Mark the intersection of this line with scale C_2. Locate 75% on the scale O and connect this point with a straight line with the point 147,000 on O_3. Locate the point of intersection of this line on scale O_2 and connect this point with the point previously found on scale C_2. Where this line intersects the scale G we find that approximately 163 gal. of oil for the conditions given are equivalent to one ton of the coal under its conditions.

The Part Electric Motors Play in the Oil Burner Picture

HAVING read a great number of articles about oil burners treating on efficiencies, installation, marketing problems, and a wide variety of subjects, I have long felt that some discussion of the part played by the electric motor deserves some consideration. While the motor may not be conceded to be the heart of the burner by all who are qualified to pass judgment, still it is of vital importance and has received the most exhaustive engineering scrutiny. A defective motor will shut the burner off without damaging other elements, but a defective pump, control or valve quite frequently causes the ruin of an otherwise perfect motor.

There are three types of single-phase motors used on oil burners; namely, the split phase, the capacitor, and the repulsion induction. The split phase, used to the largest extent, is the simplest mechanically, employing the least number of parts where trouble might develop. Split phase motors develop less starting torque per ampere of starting current than the other types, but they are capable of starting most pressure atomizing burners used in domestic work and are used almost entirely for rotary burners.

A motor coming into favor for vertical rotary burners, in the last few years, is the straight condenser type. This motor has a paper condenser in the circuit at all times, which takes the place of the centrifugal starting switch, and it is interesting to note that the centrifugal switch, no matter how well made and designed, is the seat of the greatest amount of motor trouble, that is, trouble originating in the motor itself.

One of the most frequent complaints has to do with noisy motors, and while it is true that this is sometimes justified, the noise frequently originates in some other part of the burner. Pumps sometimes are not properly fitted, or the fan is unbalanced. Then again, vibrations can be set up or air gets into the fuel line. On one occasion, two identical motors were shipped to two different manufacturers. One pronounced his sample as the quietest motor he had yet observed, and the other was even more positive that his was the most noisy. What ultimately happened was not learned, but before long the second manufacturer accepted the motor as standard without further comment. The motor, being the prime mover of the burner, is the first element to be condemned if noise develops or the burner fails to start. As often as not, the seat of the trouble is located somewhere else.

This month's cover illustration shows two Electrol oil burners in the Newton (Mass.) Police Station. Several adjacent municipal buildings are also heated by the same burners and boilers, the total load being 20,000 sq. ft.

In serving the oil burner industry, motor manufacturers have been called upon to develop a wide range of designs to suit different purposes, as no standardization has yet developed. Motors are built for foot mounting on both rigid and cushion bases, and for end bell mounting. The vertical rotary burners require motors to operate in the vertical position, and to make it even harder, to be located in the ash-pit of the furnace, where they are comparatively inaccessible. It is worth noting that until the advent of this type of rotary burner, motors for vertical operation, especially in such a location as the ash-pit of a furnace, had never been built in any quantity and most people viewed the advent of the rotary burner with hearty skepticism for this very reason.

First cost of motors has received more and more attention, especially in these times, and the manufacturer has asked why he must pay from 50% to 100% more for his motors than motors of equivalent rating cost for washing machines or other short-hour appliances.

The answer is that the oil burner motor performs an important function in the average household, and often operates under very difficult conditions. It must drive the burner faithfully when heat is called for. If the refrigerator motor fails, food gets warm, and that is that. If the washing machine motor fails, the clothes must be hand washed, and that is that. If the oil burner motor fails, however, the household is cold, human comfort is imperiled, and there are plenty of protests.

One of the questions most frequently raised by the dealer and service man concerns the lubrication of the motor bearings. There is almost as much danger from over-oiling as from under-oiling, as the excess usually finds its way inside the motor, coming to rest either on the centrifugal switch or the windings. Most manufacturers supply enough lubricant in the reservoirs when the motor is shipped for the first few months operation. In general, it might be said that if oiling is done at the very beginning of the heating season and every second month thereafter, it will be ample. Caution should be observed to oil the bearings properly but not flood the motor.

The oil burner motor must be a quiet, reliable, efficient and faithful servant ready to work twenty-four hours a day, and it receives notice only when it fails. *—R. N. Jessop, Motor Sales Manager, The Ohio Electric Mfg. Company.*

Cooling Small Stores with Ice—Operating Data

By J. N. LIVERMORE†

Last month the author described the design and layout of the ice-cooling systems in two Michigan buildings. In this article he summarizes the results obtained.

IN a preceding article the design of two ice installations for cooling the Detroit Edison Company's sales offices were described. These were at Port Huron, Mich., and at Farmer Street in Detroit. They were in operation during the summer of 1932, and the following is a discussion of data and observations taken from them.

Fig. 1 shows a typical set of performance curves, and illustrates the results obtained during a typical hot day in Port Huron. The estimated amount of ice melted on that day was 7000 lb., giving an equivalent average refrigerating capacity (including losses) for the 8-hr. operating period of 11.66 tons. The maximum load of 14.2 tons is well within the design capacity of 17.7 tons, and at no time during the cooling season was the spare capacity used except on starting up in the morning. Since the office was not cooled during the night, this margin was of value in shortening the morning cooling-off period.

At first glance these curves would lead one to expect that the load would increase with the rise of outdoor temperature. However, the dcrease shown is largely due to the fact that the building faces east exposing most of the glass area to the sun during the morning. The rear of the office is shaded by neighboring buildings beginning shortly after noon. Apparently, this decrease of sun effect more than offsets the increase of load due to the rise of outdoor temperature and heat content of air infiltrated. Sufficient outdoor air was brought in by general infiltration and the opening of outside doors, that a positive source of outdoor air proved unnecessary. The system was thus operated completely recirculating. Even in winter this means is used to keep the upstairs rooms from becoming stuffy.

Fig. 2 shows typical performance curves for the system at the Farmer Street Sales Office. At this location there is a connected interior electrical load of approximately 37.2 kw., a greater part of which is used for display lighting purposes. While the use of this lighting was somewhat restricted for economy's sake, it accounts for roughly 50% of the cooling load indicated. With the office surrounded by high buildings, and the room air being almost 100% recirculated, there was little to cause fluctuations in the cooling load.

At Farmer Street, changes were made during the cooling season to such an extent that totals and averages of data taken for the season are of little significance. The changes made were in the automatic control and room conditions maintained and will be discussed later. Suffice it to say, that on a maximum day approximately five tons of ice were melted and for

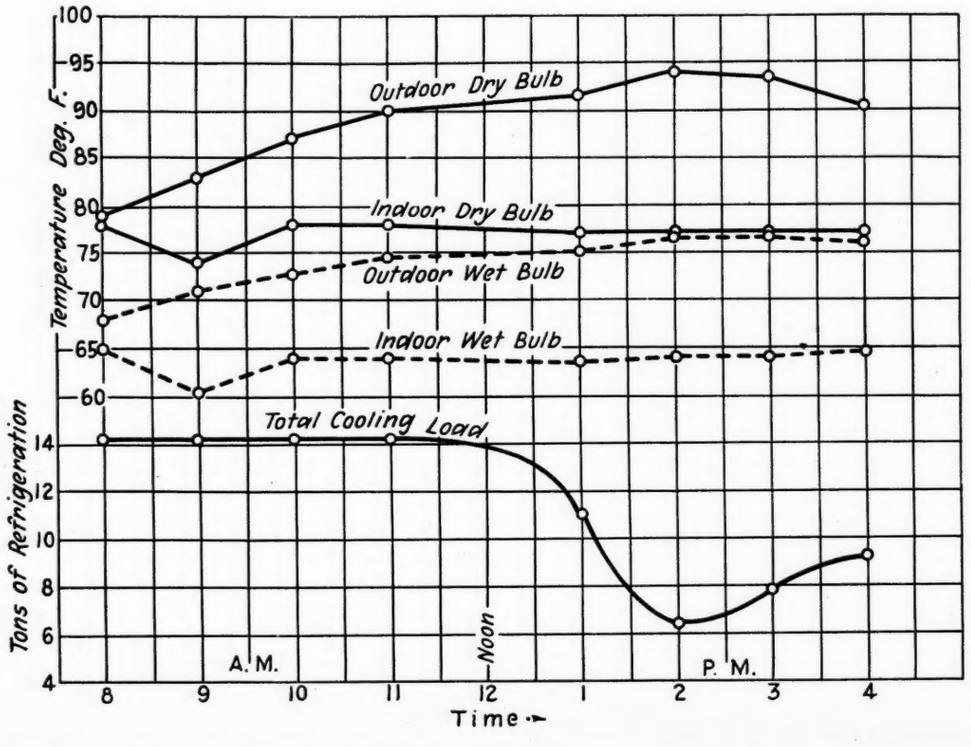


Fig. 1. Typical set of performance curves showing results obtained during an average hot day in Port Huron.

†Design Engineer, Drafting and Survey Bureau, The Detroit Edison Company.

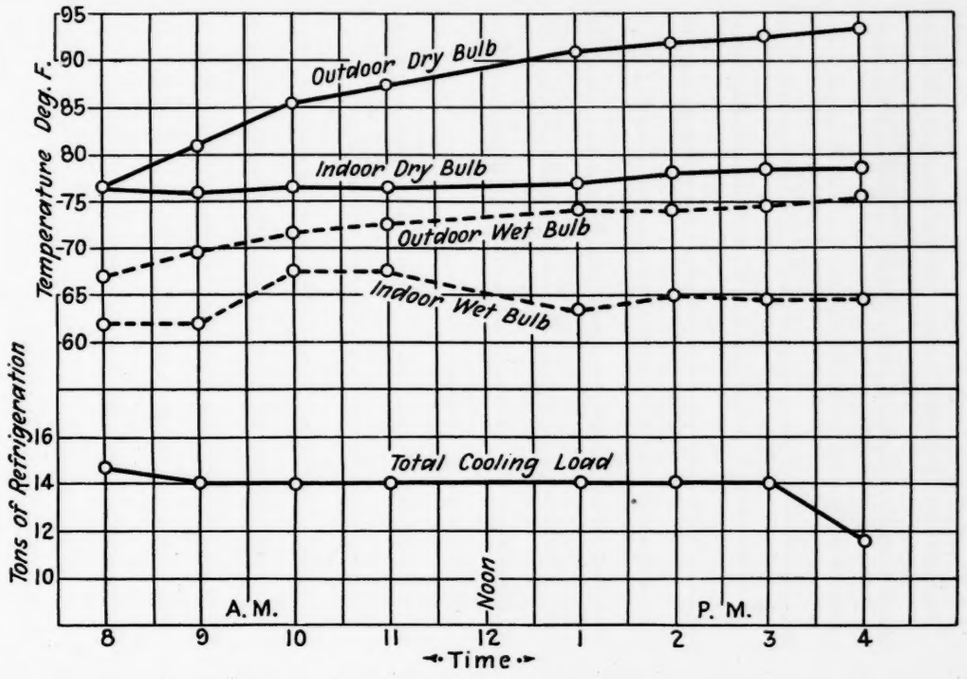


Fig. 2. Typical performance curves for the ice-cooling system in the Farmer Street Sales Office.

the season approximately 330 tons were used.

At both Port Huron and Farmer Street, readings of load were of more value for purposes of comparison than for quantitative use. The loads were calculated from readings of the inlet and outlet water temperature on the cooling coils, and from the known rate of water flow. An error of 1° in reading these temperatures would result in an error of between one and two tons difference in the cooling load computed. Table 1 is a typical log sheet for Port Huron.

The Port Huron data are especially interesting because they can be compared directly with those of a system operated at the company's Ann Arbor Sales Office which was cooled by means of a CO_2 ice machine. Both had approximately the same calculated daily load and a complete record of operating data was kept from June 1 to September 15, 1932. A cost comparison for the two systems, as closely as can be estimated, is as follows:

	Port Huron	Ann Arbor
First cost	$5700.00	$10,800.00
Total operating cost.....	1187.00	430.00
Fixed charges	917.00	1728.00
Total annual cost.....	$2099.00	$2158.00

Considering the fact that the amount of cooling affected at the two locations may or may not have been *exactly* equal, one may say that the total annual cost for either of these installations is substantially the same. When the first cost of either of these is once "over the dam" however, this quality is not apparent to the average owner. The heavy operating charges for ice cooling loom large in the user's eyes, and in times calling for economy, he is tempted to use it only when the benefits are very noticeable. On the other hand, the investment charges of the mechanically-cooled system may continue rather painlessly, and the owner finds that his operating costs are sufficiently small to warrant using it freely. However mistaken this reaction may be, it has already been encountered among the users of these systems, and must not be overlooked in comparing the merits of the cooling methods.

The Farmer Street Sales Office is only a five-minute walk from the main office of the company, and being so convenient became more of an experimental laboratory than a permanent installation being given a trial run for a season. At the outset, it was agreed that it would be desirable to maintain a schedule of indoor conditions relative to outdoor temperature, as commonly recommended for comfort cooling. Difficulty was encountered in maintaining this schedule, however, even with a highly-trained operator on hand to change the thermostat setting from hour to hour. In general,

TABLE 1
PORT HURON LOG SHEET, JULY 13, 1932

	Outside Conditions							Cooling Coils											
	Temp.				Check			Entering Air				Leaving Air				Cooling Water Temp.			
Time	Dry Bulb	Wet Bulb	Rel. Humid., %	Dewpoint	Clear	Sun Obscured	Rain	Dry Bulb	Wet Bulb	Rel. Humid., %	Dewpoint	Dry Bulb	Wet Bulb	Rel. Humid., %	Dewpoint	Ice Tank	Entering Coils	Leaving Coils	Pounds of Ice Delivered
8 a.m.	79	68	57	62.5	..	..	..	78	65	50	58	59	56.5	85	54.5	42	46	54	4 Tons
9	83	71	55	65 5	..	..	..	74	62	51	55	57	55	88	53.5	42	46	54	
10	87	72.5	49	66	..	..	..	78	64	46	56	63.5	59	77	56	40	48	56	
11	90	74.5	47	67.5	..	..	..	78	64	46	56	63.5	59	79	56	40	47	55	
12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
1 p.m.	91.5	75	46	68.5	..	..	..	77	63.5	47	55.5	67	60.5	69	56.5	40	48	54	
2	94	76.5	45	70	..	..	..	77	64	49	56.5	67.5	61	70	57	40	50	53	
3	93.5	76.5	46	70	..	..	..	77	64	49	56.5	69	61.5	66	57	40	50	54	
4	90.5	75	50	69	..	..	..	77	64.5	51	57.5	69	61.5	66	57	41	50	55	

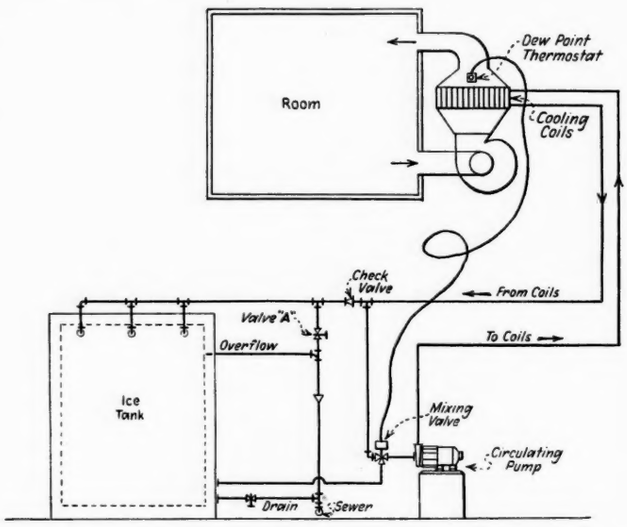


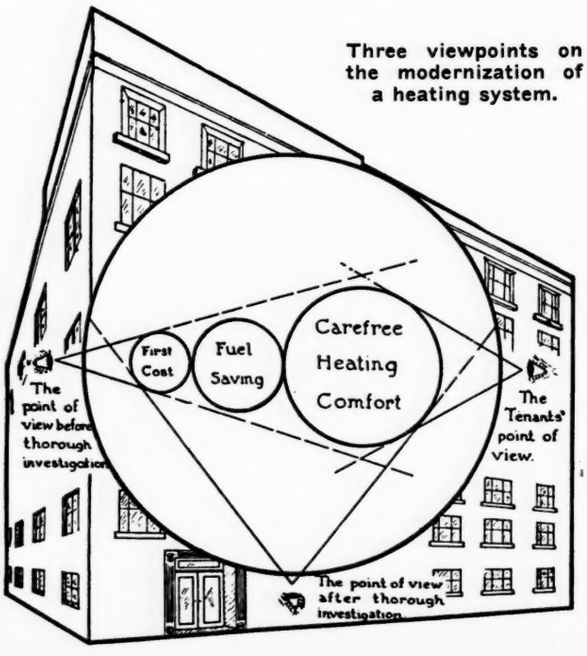
Fig. 3. Schematic diagram which automatically starts the cold water circulating pump when the room warms up and maintains room conditions at the desired point.

thermostats require some little time to reach equilibrium with the room temperature. Continual resetting gave far from satisfactory control, and at Farmer Street a device was sought which would automatically cause room conditions to follow the ideal schedule. This was approximated in the use of a mercury switch which a compound element opens or closes depending on the difference between indoor and outdoor temperature. The switch, in turn, starts the cold water circulating pump. While this device bore no relation to the other devices already installed, it seemed to give results entirely satisfactory to the occupants.

This leads the writer to believe that in many instances, automatic controls are provided beyond any necessity. In this case, with the pump frequently starting and stopping, there was little or no time for the return and ice water mixing valve to operate effectively. Thus, the humidity control which had been provided was virtually out of use, and while the relative humidity in the room varied more widely than before, this was not noticeable to the occupants. This is not surprising when we view the performance of the unit type of cooler. In this device, no attempt is made to vary the surface temperature of the cooling coils to regulate the amount of dehumidifying accomplished. In the direct expansion type the refrigerant boils at constant pressure producing a fairly constant coil surface temperature. In the cold water type, cold water is circulated at a constant supply temperature. The Detroit Edison Company has one installation of these units where about nine tons of cooling capacity is required in one room, and the results as to room relative humidity, so far as the occupants are concerned, are equal to those attained by installations with close automatic regulation.

As may be noted in Table 1, the temperature of the water leaving the ice tank remains very steady throughout the day, at about 40°. The use of water at this temperature produces too high a degree of dehumidification and, consequently, the dewpoint thermostat calls for water at a higher temperature—about 54°. It is probable that the constant temperature of the water in the ice tank could be utilized, and a fairly steady supply temperature maintained by substituting two hand valves in place of the mixing valve and dewpoint thermostat. A single setting of valves controlling the amount of return water mixed with the ice water would doubtless give sufficient humidity control to satisfy all practical needs, and in certain cases might never need to be changed.

Different Views on Modernization


First Cost
Fuel Saving
Carefree Heating Comfort
The point of view before thorough investigation
The Tenants' point of view.
The point of view after thorough investigation

Three viewpoints on the modernization of a heating system.

THREE different ways of looking at modernization are described and illustrated by Oliver J. Prentice in the January issue of *Skyscraper Management,* the journal of the National Association of Building Owners and Managers. The illustration is reproduced through the courtesy of that publication.

In his article, Mr. Prentice says: "Point of view determines perspective. A ten-cent piece held close to the eye will eclipse the sun. An immediate expenditure may monopolize attention to the exclusion of the benefit it would bring. Owners are faced with the tenant's demand for comfort. Unfortunately, this is in many respects a tenant's market. The diagram read from right to left visualizes the tenant's point of view. For the tenant, of course, comfort and price are the sole considerations. For the owner who views his heating problems from all productive angles, the questions of comfort, fuel saving, and first cost assume their proper proportion in the point of view found by reading the diagram upward from the lower point of the circle."

ESTIMATING DUCTWORK

Weights of Rectangular Galvanized Steel Ducts per Foot—41" x 41" to 60" x 60"

41" x 41" to 60" x 60"

| Wt. Sq. Ft. | Gauge | WEIGHT OF GALVANIZED IRON DUCT PER LINEAL FOOT | | |

ESTIMATING DUCTWORK

Areas and Weights of Round Galvanized Steel Ducts per Foot

Diam., In.	AREA Sq. Ft. per Ft.	WEIGHT, LB. PER FT. 26 Ga.	24 Ga.	22 Ga.
4	1.05	1.03	1.31	....
5	1.31	1.27	1.62	....
6	1.57	1.51	1.92	....
7	1.83	1.74	2.22	....
8	2.09	1.98	2.52	....
9	2.36	2.22	2.83	....
10	2.62	2.54	3.23	....
11	2.88	2.78	3.53	....
12	3.14	3.01	3.83	....
13	3.40	3.25	4.13	....
14	3.67	3.49	4.45	....
15	3.93	3.73	4.75	....
16	4.19	3.97	5.05	....
17	4.45	4.21	5.35	....
18	4.72	4.45	5.66	....
19	4.98	4.77	6.06	....
20	5.24	5.00	6.36	....
21	5.50	5.24	6.67	8.10
22	5.76	5.48	6.97	8.47
23	6.02	5.71	7.27	8.83
24	6.28	5.95	7.57	9.20
25	6.54	6.19	7.88	9.57
26	6.80	6.42	8.17	9.93

Diam., In.	AREA Sq. Ft. per Ft.	WEIGHT, LB. PER FT. 24 Ga.	22 Ga.	20 Ga.	18 Ga.
27	7.07	8.47	10.30	11.70	....
28	7.33	8.89	10.81	12.75	....
29	7.59	9.19	11.17	13.15	....
30	7.85	9.49	11.54	13.58	....
31	8.11	9.79	11.91	14.02	....
32	8.38	10.10	12.29	14.46	....
33	8.65	10.43	12.67	14.91	....
34	8.91	10.72	13.04	15.35	....
35	9.17	11.04	13.41	15.78	....
36	9.43	11.32	13.78	16.23	21.12
37	9.69	....	14.16	16.78	21.84
38	9.95	....	14.62	17.20	22.39
39	10.21	....	14.99	17.64	22.95
40	10.47	....	15.35	18.07	23.51
41	10.73	....	15.71	18.50	24.07
42	10.99	....	16.09	18.92	24.65
43	11.26	....	16.48	19.37	25.22
44	11.52	....	16.82	19.80	25.80
45	11.78	....	17.20	20.24	26.35
46	12.04	....	17.58	20.68	26.90
47	12.30	....	....	21.23	27.65
48	12.56	....	....	21.67	28.21
49	12.83	....	....	22.10	28.77

Diam., In.	AREA Sq. Ft. per Ft.	WEIGHT, LB. PER FT. 20 Ga.	18 Ga.	16 Ga.
50	13.09	22.55	29.35	36.15
51	13.35	22.98	29.90	36.84
52	13.61	23.42	30.47	37.53
53	13.87	23.86	31.03	38.23
54	14.13	24.29	31.60	38.93
55	14.39	24.73	32.18	39.63
56	14.65	25.27	32.88	40.53
57	14.92	25.72	33.48	41.33
58	15.19	26.17	34.06	42.02
59	15.45	26.61	34.64	42.71
60	15.71	27.04	35.20	43.40
61	15.97	....	35.76	44.09
62	16.23	....	36.33	44.78
63	16.50	....	36.89	45.47
64	16.76	....	37.46	46.16
65	17.02	....	38.22	47.05
66	17.29	....	38.77	47.75
67	17.55	....	39.42	48.54
68	17.81	....	39.87	49.14
69	18.07	....	40.44	49.85
70	18.33	....	41.01	50.55
71	18.60	....	41.60	51.25
72	18.86	....	42.16	51.95

Surface areas in square feet per linear foot, and weights in pounds per linear foot for galvanized steel ducts from 4 in. to 72 in. in diameter are given in the accompanying figures. The weights include allowance for seams, on the assumption that ducts are cut from sheets 30 in. wide, and that one lap of 1 in. is required for each sheet. Thus ducts up to 9 in. in diameter contain one lap, and so on up to ducts of 72 in. diameter, which contain 8 laps. No allowance is made for waste, bracing or hanging.

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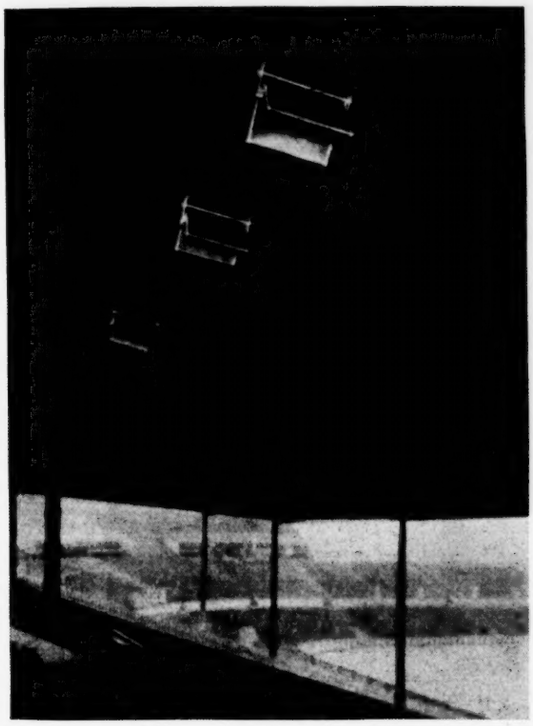
Heating—Of All Things—A Football Grandstand

UNDISMAYED by tradition, heating engineers in Great Britain have made an installation which apparently accomplishes the impossible in heating the great outdoors. The installation is in the grandstand of the Manchester United Football Club, according to *The Heating and Ventilating Engineer,* (Great Britain), and was made by Ferranti, Ltd., Hollinwood, England, the firm's interest having been aroused by press notices which declared the problem to be one impossible of solution.



Electric radiant heaters in Manchester grandstand

Actually, however, the method used will not be so wasteful or so radical as might be expected, for instead of heating the space by conventional methods, electric radiant heaters are employed. The air is transparent to the radiant rays so that the heat emitted is largely absorbed by the spectators. In the experimental installation, 50 seats will be heated by four 2½-kw. units suspended overhead.

Naturally, this method of heating cannot entirely nullify the effects of a really cold wind blowing direct on to the spectators. The natural layout, however, of a large football ground, fortunately provides some measure of protection against the effects of such a wind, and there is no doubt that by the use of this system of heating, the comfort of the spectators is enhanced. It is obvious, too, that the chances of success in the heating of the whole of the stand are much greater than those of heating merely a small part of the stand as has been done up to now. The load that would be necessary in order to cater for, say, 20,000 people would, of course, be a heavy one, and on this account, the first cost of installation might be fairly high, but the cost of running would be very low, since in the ordinary way the heat is required only for 2 hr. in the week at a time of off-peak load, for which an attractive tariff could be offered.

British Fuel Research Leading to Improved Heating

A REPORT which has just been issued by the British Fuel Research Board provides glimpses of a new heating era in the United Kingdom, the coming of a bright smokeless fuel, yielded after many products have been extracted from the raw coal.

"The production of a free-burning smokeless domestic fuel is perhaps the main object of low-temperature carbonization," says the report, and it makes the interesting disclosure that for some time now certain government offices in London have been supplied with such a fuel, burning in specially designed open grates made of polished aluminum sheet, capable of giving radiant heat and a bright reflection.

Allowing for the fact that low-temperature coke is about 20% more efficient as a heating agent than raw coal, it is, as produced by existing processes, more costly than coal. In spite of this, Dr. Charles Carpenter, chairman and technical expert of the South Metropolitan Gas Company, London, declares that a demand for such fuel is being rapidly established in working-class districts, where the cleanness and lightness of the fuel even permit its being sold in paper bags. The red-hot glowing fire it produces appears to make it very attractive to those who have one fire only for both cooking and heating, and also to those who like the appearance of an open fire yet cannot tolerate its dirt.

The fact that fuel of this description can attract the working class customer at its present price appears to be a strong indication that the demand for it will spread rapidly if the prices can be reduced by technical improvements in the process of its manufacture. The general use of the new brick retorts should be likely to make a reduction possible in the price at which it is necessary to market this new smokeless heating medium.—*A. C. Blackall.*

Abstracts . . .

Reviews and Summaries of . . . . Current Papers, Books and Pamphlets

Collection of Working Charts on Refrigeration Published

CONCENTRATING a number of working curves into one set of covers of such a size that they can be filed vertically in the usual office file is an idea which must appeal to the author of "Engineers' Condensed Data," who evidently likes to be able to put his finger on a convenient chart when he wants it. He has plotted 76 rectangular charts on standard cross-section paper and they are reproduced in green ink with each chart large enough to make the values readable. Brief instructions concerning the nature and use of each chart are included, as are a few tables of miscellaneous data at the back. Charts deal principally with relations of data commonly used in ice-making and refrigeration plant design.

[*Title: "Engineers' Condensed Data," by Clarence C. Fichter, M.E.; cloth or morocco bound;* 142 *pages; Nickerson & Collins Co.; price, in cloth* $7.50; *in morocco,* $8.50.]

●

Building Conference Volume Predicts Growth of Gas Heat

THE 11th volume of the publication of the President's Conference on Home Building and Home Ownership, published recently, is devoted to a study of objectives and programs to be followed. Of primary interest to engineers is the material relating to the technological developments, included in which are statements relating to insulation, standardized homes, heating, refrigeration, and air conditioning.

In the opinion of the authors, future heating plants in houses will use gas fuel exclusively, and some of the conclusions along these lines are controversial. It is doubtful, for instance, that all engineers will agree with the statement that "Efficiencies [with gas] as high as 85% are commonly reported, and it is probable that 75% may be relied upon as an average over long periods of time with first-class equipment." Nor does it seem that the oil burner interests will accept without reservations the conclusion that "A review of the subject, therefore, indicates that without any further technical advances a city could be heated at less total cost for everything connected with the enterprise if raw fuel was first converted into gas which is distributed and burned than if the raw fuel is burned directly. In other respects the advantages of gas heating would be enormous." Another rather sweeping statement is to the effect that "All other factors to be considered are greatly in favor of the use of gas."

Following are abstracts from the conclusions relating to air conditioning:

"Although many investigations have been made of the effect of air conditions upon the human organism, sufficient information is not as yet available to determine the best conditions for comfort and for mental and physical efficiency . . . . ."

"In most houses during the winter the air is above the temperature of the walls. Investigation might show that if this condition were reversed, the walls being at a considerable higher temperature than the air, the occupants would be perfectly comfortable if the air temperature were only 50°. The explanation offered is that comfort depends greatly upon radiant heat. If the walls were warm and the air cool, a person might have the exhilaration experienced when out-of-doors in frosty weather when the sun is shining brightly. The Fuel Research Board of Great Britain has made investigations of this subject. More work is needed to determine the possibilities."

"The low humidity of the air in American homes has been condemned as detrimental to the membranes of the nose and throat and as a cause of rapid deterioration of the furniture in the house. It may be that methods should be developed for maintaining a humidity throughout the year which is satisfactory. There is no doubt that the low humidity in most houses during the winter is detrimental to wood furniture. Its effect upon the comfort of the occupants is not very noticeable. There is no conclusive evidence that it is detrimental to health . . . . ."

"It may be found that there is a sufficient benefit from circulating the air in the house to justify mechanical ventilation in the future. The intake for outside air could then be on the roof or in some other favorable location to reduce the amount of dust and dirt . . . ."

"If small houses are designed and built which are well insulated and tight so that they are economically heated in winter, they will be cooler in summer than houses which do not have these advantages . . . ."

"The temperature of the air in a house can be lowered in summer without refrigerating equipment, by mechanical ventilation—drawing the outside air from the coolest spot near the house . . . . ."

"Although it is not practicable at present to use refrigeration to cool the entire house, it is economically feasible to cool one room during the summer, preferably a room on the second floor which could be used as a living room and sleeping room. Equipment is now available for a room of moderate size for cooling by refrigeration in summer and heating, ventilating and humidifying in winter at a cost of less than $1000. This equipment may be either self-contained in a cabinet or installed in a closet or in the cellar . . . . ."

"It is not generally realized that a sick-room can be

cooled in hot weather by an inexpensive unit holding about 300 lb. of ice and provided with an electrically-driven blower to circulate the air. This would cool the air in a small room for about 10 hr. during the heat of the day."

"The development of complete air conditioning plants for homes, whether as combined heating, cooling and humidifying units, or as separate units, deserves extensive investigation."

"Cooling installations using the absorption of refrigerants by silica-gel heated by gas have been tried out in residences, and there are also mechanical cooling systems commercially available for higher-priced homes."

"All the data so far available indicate that at present these systems gave too high first costs and too large operating costs to be considered for houses in the lower-price ranges. Further technological development may be expected to make lower-priced equipment available in the near future but there is no indication at present that it will be economically available to everyone."

"One application of mechanical ventilation which has been used, apparently with beneficial results, is an exhaust fan in a short stack on the roof. There are about 2 ft. between the ceiling of the upper story and the roof. Air is drawn through openings under the eaves and between the ceiling and roof and discharged through the stack. Operation of the fan for a few hours in the evening makes the bedrooms in the upper story much more comfortable in hot weather."

[*Title: "Housing Objectives and Programs," Vol. XI of the President's Conference on Home Building and Home Ownership. Cloth-bound, 6¼ in. × 9¼ in., 345 pp. Obtainable for $1.15, postage prepaid, from the Conference offices at 42 Broadway, New York.*]

●

British Study Effects of Humidity and High Temperatures on Capacity for Work

THE physiological action of two subjects was investigated in air at a temperature of 70°–100° and of 40%–92% relative humidity. The experiments lasted three hours, and one of the subjects performed mechanical work (step climbing) at the rate of 14,000 kilogram meters per hour.

The pulse rate was about 10 beats greater in dry air than in moist air of the same wet bulb temperature. The winter observations agreed well with the effective temperature scale, but did not agree with the wet bulb, the dry bulb, or the kata thermometer scales.

Acclimatization effects showed themselves in experiments made at a dry bulb temperature of 87° or more, but only very slightly in those made at 81° or less. Acclimatization was fairly well marked in the summer, the pulse rate being 5 to 10 beats less than in the winter, and no longer agreeing with the effective temperature scale.

The body temperature corresponded with the pulse rate, for it was 0.3°–0.6° higher in dry air than in moist air of the same wet bulb temperature, and was 0.15° lower in summer than in winter. The winter observations agreed well with the effective temperature scale.

The skin temperature of the face was found to depend on the dry bulb temperature of the air, but that of the trunk showed no agreement with any of the scales. In moist air it was 1° lower than that of the face, and in dry air, 6° lower, owing to the cooling effect of increased sweating.

The gross mechanical efficiency fell off slightly at temperatures above 70° or 75°. It was affected by the dry bulb temperature of the air as well as the wet bulb, but not to the extent indicated by the effective temperature scale.

The weight of moisture lost by sweating corresponded well with the effective temperature scale. It increased gradually in consecutive experiments made in dry air, and diminished in those made in moist air.

The degree of fatigue experienced in dry air was considerably greater than in moist air of the same wet bulb temperature, and it corresponded with the effective temperature scale.

[*Title: "Influence of Humidity of Air on Capacity for Work at High Temperatures," by H. M. Vernon and C. G. Warner; Journal of Hygiene, Great Britain, July,* 1932.]

●

Farm House Construction Covered in Conference Report

WHILE plenty of books have been available on city and suburban housing, few have concerned themselves with rural houses. In volume seven "Farm and Village Housing" of the publications of The President's Conference on Home Building and Home Ownership, material has been assembled covering studies of existing buildings, economics of rural housing, financing, relation of housing and health, design and construction, and an outline of research and promotional work which should be done for improvement in farmsteads.

Among the figures presented are the results of a survey covering a number of houses in different sections and showing the method of heating. As might be expected, the greatest percentage of central heated houses are found in the New England-New York and Northern Dairy regions. Figures are also given on the number and percentage of homes (by states) having water piped in and with electric light.

The committee, in its recommendations to builders, has this to say regarding heating:

"*Stoves.* Stoves are an improvement over fireplaces and are good heaters. Some ventilation is provided by stoves. However, such heating is unequal and the parts of the room distant from the stove may be less comfortable, while in the vicinity of the stove it might become too hot to be agreeable.

"*Open Gas and Oil Heaters.* Both open gas and oil heaters are very objectionable; they are inefficient, and neither aids in ventilating a room. The oil heaters are less objectionable than the gas heaters, though without adequate ventilating flues both pollute the air with com-

bustion products and unconsumed gases of which carbon monoxide is the most dangerous.

"Warm-air Furnaces. Warm-air furnaces are an improvement over the types of heaters just mentioned but, of course, are more expensive to install and maintain. The objection to them lies in the high temperatures necessary to be maintained at the registers, the odors from burned dust, and the extreme dryness of the heated air at the registers when humidifiers are not used.

"Hot-water and Steam Heaters. The advantages of hot-water and steam furnaces are cleanliness and ease of central operation, while the disadvantages are expense and abnormal drying of the air since higher air temperatures are generally maintained. The radiators contribute little to natural ventilation but lend themselves readily to 'window' ventilation.

"Electric Heaters. Electricity, when available, lends itself readily to heating of the house and electric heaters are clean, easily regulated, but expensive to operate in comparison with other heaters."

[*Title: "Farm and Village Housing," Vol. VII of the President's Conference on Home Building and Home Ownership; 6¼ in. × 9¼ in.; cloth-bound; price* $1.15, *postpaid. Checks payable to James Ford, Editor,* 42 *Broadway, New York.*]

●

Commercial Standards for Fibre Insulating Board Now Available

COMMERCIAL standards for fiber insulating board as accepted by the industry have been published by the Department of Commerce in pamphlet form. The standard classes board insulation in two groups—building board and roofing board—each to have a thermal conductivity of not over 0.36 B.t.u. per hr. per sq. ft. per deg. per in. thickness. The former must have a maximum water absorption of 5% and the latter of 10% by volume, while the minimum thickness for both classes is 13/32 in.

In addition to setting forth the purpose, scope, general and detail requirements of the standard, the pamphlet outlines the method of test which should be followed.

[*Title: "Fiber Insulating Board," Commercial Standard CS42-32; for sale by the Superintendent of Documents, Washington, D. C.; price,* 5 *cents; paper bound; 6 in. × 9 in.;* 11 *pp.*]

●

Data on Heat Transmission Collected and Arranged in One Volume

HEAT transmission is a subject so essential to the design of heating and conditioning installations that we are all more or less familiar with it, at least in the applications to our work. What many of us do not appreciate is how widely the basic information is used. Being so much in demand, many investigations have been made to collect data for particular uses. As these have often been carried on by workers who did not consult with each other, and as the separate studies were usually concerned with some special problem, the result has been a great confusion of terms in published papers. The present book, prepared under the auspices of the Committee on Heat Transmission of the National Research Council, is comprehensive and aims to collate and correlate the findings, putting them into an orderly arrangement and using uniform terms and symbols. This it succeeds in doing admirably. Moreover, the applications are driven home by using the problems-and-solution method. A number of these problems use the subject matter of air heating or cooling and are direct applications to our field.

Being written in the style of a review of the findings of others and with comments on their work, the reading is not as laborious as is so frequently the case with books of similar character. In spots, where resort to mathematical presentation is necessary the going is not easy. On the other hand emphasis is not placed on mathematical methods. The charts and graphs are in usable size. The extensive bibliography of about 500 titles is a notable feature.

The organization of the material is carried out along logical lines with cross references and with footnotes containing both clarifying comments by the authors and references to the bibliography. Anyone who works close to the essentials of heat transmission will find the book invaluable. The chapter headings show the content and arrangement.

Conduction; Heating and Cooling of Solids; Radiation of Heat; Dimensional Analysis; Flow of Fluids; Introduction to Convection; Fluids Outside Pipes; Fluids Inside Pipes; Condensing Vapors; Heat Transfer to Boiling Liquids; Appendix (Tables of Data); Index to Principal Relations for Convection; Bibliography and Author Index; Subject Index.

[*Title: "Heat Transmission," by William H. McAdams; cloth-bound; McGraw-Hill Book Co., Inc.; price,* $5*; 6 in. × 9 in.;* 383 *pages.*]

●

High Humidities Recommended for Cow Barn Ventilation

COW barn ventilation is peculiar, and cow barns are one of the few types of buildings heated by animal heat. These are merely a few of the impressions resulting from a careful reading of A. J. Offner's paper in which the author goes exhaustively into the subject of the ventilation of cow barns. He not only discusses types and breeds of cows, and shows that artificial ventilation is necessary and desirable to promote milk production and to insure clean and marketable milk, but the technical material is unusual, and exceptionally well presented. After reading the paper one concludes that there is little else to be said, for the latest data are assembled and sketches show how applications are made.

From 2600 to 3500 cu. ft. of air per cow per hour

are required for ventilation, the larger amount being necessary in the warm climate zones of the United States. It has been found that temperatures of from 45° to 55° are the most desirable for design purposes. Rather high relative humidities are used and are obtained by the use of outside air. Insulation of cold surfaces and of metal parts is usually necessary to prevent condensation and dripping. In the usual design it is desirable to construct the barn of reasonably good heat resistance materials in order that a suitable balance between ventilation air and building heat loss may be obtained without having to restrict the air quantity too greatly in cold weather.

Air distribution is an important consideration in the installation. It must be introduced and exhausted without noticeable drafts and still must prove effective in maintaining temperature. Both upward and downward distribution methods are used. Gravity supply and exhaust is popular, but mechanical means are available and used when their ability to insure positive circulation justifies their cost. Where gravity flow is used back-draft dampers should be supplied in order to prevent possible reversal of flow. Control of operation is by hand in the usual case.

[*Title: "Cow Barn Ventilation," by A. J. Offner, A.S.H.V.E. paper, annual meeting,* 1933; *approximately* 6000 *words, illustrated with sketches; bibliography of* 16 *titles.*]

●

Coal Men Compare Fuel Efficiencies

MUCH has been written about the comparative value of the several fuels since the time when oil began to come into prominence as a heating fuel. Most of it has emanated from the oil and gas interests who have been well fortified with tabular and efficiency data for making fuel estimates. Coal advocates have been at a disadvantage. Educational Bulletin 6, recently put out by the Committee of Ten, Coal and Heating Industries, now helps to alter this situation.

The bulletin is packed with discussions and tables intended to permit more accurate coal consumption estimating. As usual, the whole computation hinges on an assumed efficiency of the utilization apparatus. The bulletin contains the following table which sets forth the efficiencies which it states "is based on accumulated experience and represents average performance under average good operating conditions."

	Solid Fuels	
Hand-firing	(residences and small commercial)	50%
Hand-firing	(large industrial)	55%
Stoker firing	(residences and small commercial)	65%
Stoker firing	(large industrial)	70%
Pulverized coal	(medium and large plants)	75%
	Oil	
Vaporizing burner		50%
Atomizing burner	(warm-air)	60%
Atomizing burner	(steam or hot water)	65%
Atomizing burner	(industrial installations—larger type)	70%
	Gas	
Conversion burner	(warm-air heating)	60%
Conversion burner	(steam or hot water)	65%
Special gas furnace	(warm-air)	70%
Special gas furnace	(steam or hot water)	75%

It will be noted that this table concedes nothing in the way of efficiency to gas or oil devices as compared to a stoker although hand-fired coal plants are set low in the scale. Based on these figures some interesting examples of consumption are worked out and are then carried on to a cost comparison.

In addition to the estimating tables the bulletin also summarizes the principal facts and data on fuel oils and gases.

The bulletin should prove useful in making fuel estimates, particularly for coal-fired plants.

[*Title: Comparative Data on Solid, Liquid and Gaseous Fuels. A mimeographed, paper-covered pamphlet of approximately 25 pages, 8½ x 11. Published by Committee of Ten of the Coal and Heating Industries, 307 N. Michigan Ave., Chicago, Educational Bulletin No. 6. Obtainable by addressing the committee, price 20 cents.*]

●

Illinois Studies Effect of Shaft Bottom Vanes on Mine Ventilation

THE greatest opportunities for effecting economies in mine ventilation lie, as a rule, in those parts of the mine where the air is forced to move with the greatest speed. This is usually in the aircourses leading from the airshaft, sometimes called the "high velocity zone."

A study of the economy resulting from improvements in aircourses was made in 1931 by the University of Illinois, and reported in Bulletin 249 of the Engineering Experiment Station. The zones which were improved and studied in detail consist of a length of nominally straight entry, a T split with a regulator in one branch, and a square bend at the bottom of the intake shaft compartment. The improvements consisted in the clearing of the fallen debris and timbers from the aircourse, the replacement of the original regulator by one with an adjustable central discharge opening, and the enlargement of the shaft bottom outlet. Finally, a set of deflecting vanes was installed in the shaft bottom to aid in changing the course of the air from vertical to horizontal.

The results of the investigation indicated that, where the mean cross-sectional area of aircourses in the high velocity zone of a mine can be increased considerably, say 50% or more, and maintained at moderate expense without the excessive use of obstructing timbers, substantial savings in ventilation costs can be effected, and that the installation of a suitable set of vanes in a shaft bottom of the type investigated should result in net annual savings in excess of the original cost of installation.

[*Title: "The Effects on Mine Ventilation of Shaft Bottom Vanes and Improvements in Aircourses," by C. M. Smith. Obtainable without charge from the Engineering Experiment Station, Urbana, Ill.;* 6 *in.* × 9 *in.*]

Your Everyday Problems

HEATING AND VENTILATING will be glad to answer your problems relating to installation and operation of heating and ventilating systems. Letters will be answered promptly, and in some cases published anonymously. If sketches are included they should be clearly drawn. Write The Editor, HEATING AND VENTILATING, 148 Lafayette Street, New York.

QUESTION 78. *I would like to know the weight of air breathed by an average normal adult during a 24-hr. period. How does the quantity of air breathed by an individual at rest compare with the quantity breathed while exercising?* *P. F. W.*

ANSWER. An adult at rest requires about 20 cu. in. of air at each inspiration, and will make from 16 to 24 respirations per minute, so that a total of from 320 cu. in. to 480 cu. in. of air is required per minute. This is an average of about 0.23 cu. ft. per min., or a total of 330 cu. ft. per 24-hr. period. At 70° and a relative humidity of 40%, 1 cu. ft. of the air-water mixture will weigh 0.07541 lb., and 330 cu. ft. will weigh 24.9 lb. Exercise may increase the respiration requirements to 0.33 cu. ft. per min.

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QUESTION 79. *What is the specific heat of air?* *W. S. C.*

ANSWER. The specific heat of a gas is defined as the quantity of heat that must be added to a unit of weight of the gas to raise its temperature 1°. In the English system of units, the specific heat is the quantity of heat, in B.t.u., that must be added to 1 lb. of the gas to raise its temperature 1° F. Since a gas expands upon being heated at constant pressure, work is done against that pressure, and therefore the specific heat of a gas at constant pressure will differ from the specific heat of a gas at constant temperature.

Heating and cooling of air in air conditioning work is nearly always carried out at constant (atmospheric) pressure, for which the specific heat is taken as 0.2415 B.t.u.

●

QUESTION 80. *Can air be dehumidified during warm weather by passing it through a spray of cold water or by causing it to flow over blocks of ice? How is this possible when the air is in actual contact with water?* *R. W. B.*

ANSWER. In a properly designed washer, the air can be cooled to within a few degrees of the temperature of the spray water, and if this be cold enough, a very appreciable amount of dehumidification can be accomplished. In this case, heat will be transferred to the water by conduction and no evaporation will take place.

As the wet bulb and dry bulb temperatures are lowered the difference between them becomes less and less, and they exactly coincide at the dew point. Then as the air is cooled below the dew point moisture is condensed from it, lowering its *absolute humidity*. The air delivered from the washer will be saturated with moisture, but as its temperature rises as it mixes with the warmer air in the conditioned space, the relative humidity of the air in the room is lowered. The same result is obtained when air is cooled by actual contact with block ice.

●

QUESTION 81. *Addition of an annex to a garage and service station necessitates installation of another boiler to carry approximately 3100 sq. ft. of direct steam radiation in the new section. The present steam boiler, which has satisfactorily carried a load of 3900 sq. ft. of radiation, burns No. 1 anthracite buckwheat, and the owner desires to continue using this fuel in both boilers. The present boiler is connected to a 20 in. × 20 in. chimney 50 ft. high. Must we enlarge the chimney?* *M. F. H.*

ANSWER. On the basis of the information given, we assume that the present boiler has approximately 20 sq. ft. of grate area, burning about 8 lb. of coal per square feet of grate per hour. Therefore, the chimney you describe should carry the load, but there is no excess capacity when buckwheat coal is burned. The U. S. Treasury Department uses the following abbreviated formula for calculating chimney sizes for government buildings:

$$A = 1.25 \frac{G}{\sqrt{H}},$$

(when burning small anthracite coals) where A is the chimney area in square feet, G the grate area in square feet, and H the height of the chimney above the grate in feet. Since it is proposed to carry a load of 3100 sq. ft. plus 3900 sq. ft., or 7000 sq. ft. of radiation, allowing 20% for piping losses there is a total load of 8400 sq. ft. When burning a coal having a calorific value of 12,500 B.t.u. per lb., with an overall efficiency of the system conservatively assumed at 60%, a total of 32.5 sq. ft. of grate area operated at an 8 lb. per sq. ft. combustion rate will be required.

Two unknown quantities, the area and height of the chimney, are involved in the accompanying formula, making a trial solution necessary. Assume a height of 75 ft. Then

$$A = 1.25 \frac{32.5}{\sqrt{75}}$$

= 4.68 sq. ft., or 674 sq. in., area of the chimney. This would be about 26 in. by 26 in.

If the garage is located at a considerable height above sea level, say at an elevation in excess of 500 ft., a corresponding correction must be added to the chimney area to compensate for a reduced barometric pressure.

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German Sound Film Shows Heat Distribution

U. F. A., the German film company, recently released a sound motion picture film demonstrating the distribution of heat throughout a room from a radiator. The film, which shows different strata of air and enables the spectator to choose the best location for the radiator, is entitled "Unsichtbare Wolken."

Economist Addresses New York Group

Bassett Jones, consulting engineer, presented "A Quantitative Survey of Productive Economy" before approximately 120 members and guests of New York Chapter, A.S.H.V.E., at its regular meeting, March 20, at the Building Trades Club. Using charts, Mr. Jones traced in mathematical language the progress of industrial development in the Unted States since 1800, showing how the rate of production and ability to produce had increased at a rate both physically and economically impossible to maintain. This acceleration of production resulted from the application of the sciences to industry, and the retarding of this acceleration, due to physical and economic limitations, has disrupted our system.

Mr. Jones further criticized the present credit system, stating that to operate without ultimate disaster, a credit system must be devised whereby the rate of credit expansion would at all times bear a one-to-one ratio to the increase in production for that time.

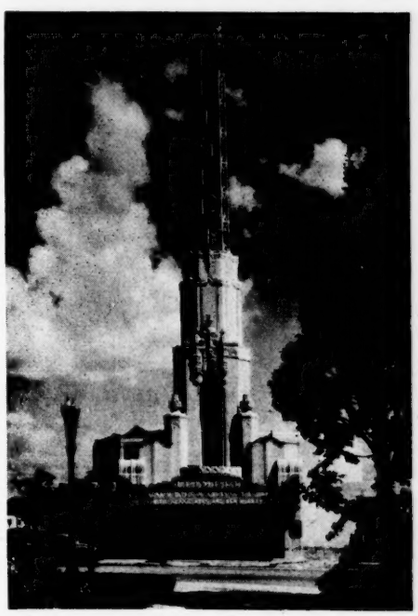
Frederick L. Ackerman, architect, prefaced Mr. Jones' discourse with brief remarks introductory to the topic.

A.I.A. Favors Plan to Curb Bid Peddling

A plan to eliminate bid peddling, formulated by Prof. Eric T. Huddleston, of the University of New Hampshire, Durham, N. H., has been endorsed by William Orr Ludlow, chairman, Committee on Industrial Relations of the American Institute of Architects, who points out that it has proven effective in localities where it has been put into practice.

In operation, the plan provides for the division of the general contractor's bid into two parts, the first containing the figure for his own work and profits, and the second embodying a list of subcontractors with their bids which the general contractor wishes to submit as making up the remainder of his total contract price. The subcontractors are notified that they may obtain a list of the general contractors submitting bids, and also that their bids are being sent to the architect as well as to the general contractors. They are further informed, under the plan, that their original bids will be accepted or rejected without modification, except for additional or less work as required by the owner. Their bids as filed should therefore be the lowest figures at which they are willing to undertake the work.

By this arrangement the general contractor is selected on the basis of the first part of his bid and the subcontractors are selected at their stated price from the entire list of those submitting bids, provided they have the approval of the general contractor with whom they are to work in the usual relationship. The Huddleston plan, it is explained, provides that the standing and ability as well as the prices of both general contractors and subcontractors will be given due consideration, and the owner will reserve the right to reject or accept any and all bids as he sees fit in the furtherance of his own interests.



The architecturally striking Leimert Theater, Los Angeles, heated by two double-tiered, 14 section Mueller furnaces burning natural gas. Morgan, Walls and Clements, architects.

Curtis Development Co. Organized

H. C. Curtis, formerly of the research department of the Allen-Bradley Company, recently formed the Curtis Development Co., 2140 North Oakland Ave., Milwaukee. The latter company will be devoted to consulting designing, development and manufacturing.

N. W. A. H. A. to Meet in Chicago

June 6-8, 1933, is the time set for the National Warm Air Heating Association convention, according to Allen W. Williams, managing director, who will be in charge of arrangements. The Stevens Hotel, Chicago, will be headquarters.

Bendix Heads Long Island Burner Dealers

At the annual meeting of the Oil Heat Association of Long Island, held at the Hempstead Elks Club, March 8, a drive was inaugurated to enlist every dealer selling or servicing oil burners on Long Island. New officers for the coming year were elected as follows: president, Charles B. Bendix, Liquid Fuel, Incorporated; vice - president, John Breckon, Rexoil Utilities; secretary, John Muller, Electrol Nassau Corporation; treasurer, Frank Mahoney, Renick & Mahoney Incorporated; director, Joseph Brockman, Brockman Engineering Corporation.

Swift Air Conditioning Corp. Formed

The Swift Air Conditioning Corp., 848 Union Ave., Memphis, Tenn., has been formed to handle the en-

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tire line of Carrier air conditioning products in the states of Arkansas, Tennessee and Mississippi.

Sales, service, and engineering departments will be maintained in Memphis, and dealers established in the important points throughout the territory.

Floyd B. Swift is president of the company, Reube O. Emery, vice-president and manager, W. P. Lovinggood, in charge of engineering, and Allen Porter in charge of service, maintenance, and installations.

Marsh Becomes Partner in Ernest E. Lee Co.

Thomas A. Marsh, formerly connected with the Green Engineering Company, Combustion Engineering Corporation, and the Modern Coal Burner Company, has become a partner in the firm of Ernest E. Lee Co., Inc., Chicago, manufacturers' representative.

Coal Producers Win Decision on Marketing

A recent decision of the United States Supreme Court resulted in a victory for the eastern bituminous coal interests when the court held that the proposed arrangements which would let the producers organize a single corporation to handle their marketing was permissable. It is expected that the decision will finally result in important changes in coal-marketing methods. Details of the plans are not available as we go to press.

Katy to Build Air-Cooled Cars

Specifications have been placed with car builders for the construction of a fleet of air-cooled lounge cars for the Missouri-Kansas-Texas Railroad, according to an announcement of the company. Cost of the new equipment is estimated at about $250,000.

Comfort Cooling Considered by West Coast Ice Men

Two discussions on the use of ice for comfort cooling received the attention of the members of the California Association of Ice Industries and the Southern California-Arizona Association of Ice Industries, assembled for joint annual meeting at Coronado, Calif., December 12-13. A paper presented on the subject by H. N. Royden pointed out that due to the fact few plant owners have the requisite technical knowledge on the subject, most of them turn to their engineers for information, thus making it advisable for the engineer to obtain a thorough understanding of the fundamentals of the subject. He then set forth the engineering essentials of air conditioning.

R. C. Walsh, California Consumers Co., Los Angeles, followed with a discourse in which a number of recent comfort cooling installations were described. The speaker asserted that in comfort cooling lay the greatest opportunity offered the ice industry to date. The low first cost of ice-cooling installations was emphasized.

Myers Engineering Equipment Co. Formed

George Myers, formerly associated with Carrier Corporation, has organized the Myers Engineering Equipment Co., 401 South 12th St., St. Louis, to specialize in air conditioning and its allied fields.

A branch office of the company in Eldorado, Ill., has been opened, in charge of John C. Porter.

Air Conditioning to be Feature of Cincinnati Show

Latest electrical appliances for heating, ventilating, and air conditioning will be on display at the Electrical Progress Exposition, to be held in the Music Hall, Cincinnati, May 8-13, under the sponsorship of the Cincinnati Electrical Club and the Cincinnati Times-Star. All divisions of the electric club are participating.

Larson Reports on Research to Illinois A. S. H. V. E.

Prof. G. L. Larson, Department of Engineering, University of Wisconsin, and chairman, Committee on Research, A.S.H.V.E., addressed the Illinois Chapter at its regular meeting, Chicago, February 13, on the subject of "Society Research Accomplishments in 1932." Professor Larson also outlined the arrangements made with the various universities which are continuing research work without financial support of the society.

John Howatt, chief engineer, Board of Education, Chicago, and chairman, A.S.H.V.E. Council Finance Committee, gave his impressions of the society's convention at Cincinnati, and Lyman R. Flook, superintendent of Buildings and Grounds, University of Chicago, entertained with an illustrated description of the carillon of 72 bells in the unniversity chapel.

Weather Forecasting Topic at Chicago Meeting

A talk on Forecasting the Weather was presented by C. A. Donnel, meteorologist, U. S. Weather Bureau, Chicago, before the Illinois Chapter, A.S.H.V.E., at its regular dinner meeting, March 13, at the Hotel Sherman. Mr. Donnel's discourse was illustrated with a two-reel film entitled Back of the Weather Forecast. The origin of weather disturbances was discussed, and the manner in which the data obtained at the various stations are distributed and organized to permit the predictions to be made was explained.

W. D. Mitchell, Water Heating Division, People's Gas Light and Coke Company, followed with a discussion on the application of gas to water heating in large office and apartment buildings. Mr. Mitchell pointed out that, with the introduction of natural gas into the Chicago territory, gas can compete with other fuels for this purpose. Attendance was 102.

British Institution Commences Publication of New Journal

Making its bow with the March issue, the Journal of the Institution of Heating and Ventilating Engineers, London, replaces the Institution's annual Volume of Proceedings, formerly the medium of publication of the papers and transactions of the society. It is proposed to devote space to reports on investigations in heating, ventilating,

and allied subjects carried out at the Building Research Station of the British Government's Department of Scientific and Industrial Research. Circulation is limited to members only.

Patterson-Kelley Appoints Haydn Myer

Haydn Myer has been appointed representative for the state of Alabama by the Patterson-Kelley Co., New York.

Funds for Building Financing Are Inadequate

Available mortgage money is not sufficient to provide for current building needs, according to information supplied to William Lucas, managing director of the Eastern Millwork Bureau, New York, in response to a questionnaire on the subject of building finance, building supply, and present status of speculative building, recently distributed among lumber mills in 16 northeastern states. Reporting the results in the Dow Service Daily Building Reports, Allen E. Beals states that there seems to be no doubt that the question of available mortgage money must be solved before any general resumpton of building can be expected.

Seventy-one communities went on record as having caught up with their building supply, against 64 which were rated as having a supply of space available in excess of the demand. Replies from Main, New Hampshire, Pennsylvania, and Virginia indicates a need for more buildings, while the returns from Vermont, Massachusstts, Connecticut, New Jersey, and Kentucky indicate that an overbuilt condition prevails generally in those states. It was further shown to be the concensus of opinion that the speculative builder has, for the present at least, lost prestige as a producer of building activity. More than 90% of the replies received recorded that the Home Loan Bank System has been of no help locally.

Rehabilitation to Dominate Midwest Engineering Exposition

Rehabilitation, repairing, remodeling, and restoring buildings and equipment, utilizing improved apparatus and supplies, will be the dominant theme of the sixth Midwest Engineering and Power Exposition, June 25-30, at Chicago. Leaders in the building field will discuss the specific problems of their industry in relation to present day conditions with the idea of outlining practical plans for rehabilitation as a good business proposition.

Twenty engineering organizations are planning conventions in Chicago to be held in conjunction with the exposition, and together with the Century of Progress Exposition, these events are expected to attract the largest group of engineers ever assembled in this country.

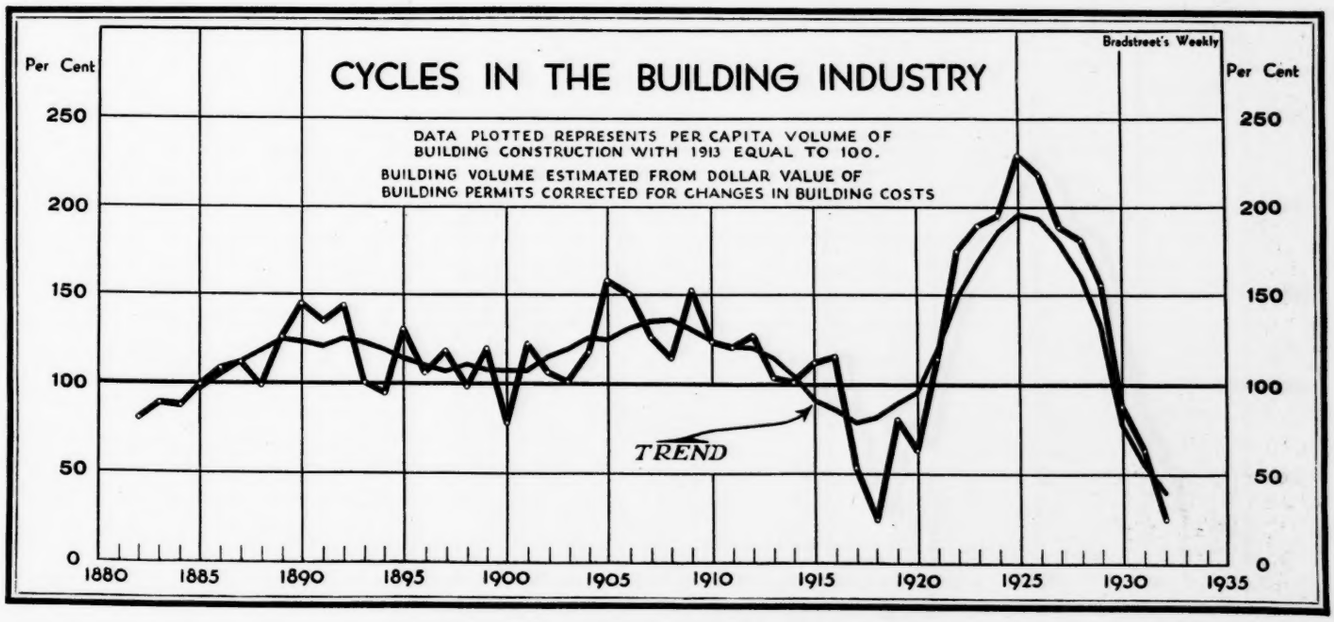
Radiant Heating Discussed Before Boston N. D. H. A.

A paper, "Connecting the Consumer and Assisting Him in the Economical Use of Steam," was presented by A. A. Beaulieu before 43 members and guests of the Boston Section, N.D.H.A. assembled for its second meeting, March 1, at the Engineers Club. Typical piping connections and graphical representations of savings accomplished through various utilization methods were shown on slides accompanying the paper. This was followed by a talk on panel heating by Ralph Franklin, of Albert B. Franklin, Inc., Boston.

William J. Hajek, Minneapolis-Honeywell Regulator Company, spoke on "Automatic Control of Heating."

Fretz and Devlin Merge

Offices and plant headquarters of S. S. Fretz, Jr. & Company have been moved from Philadelphia to



BUILDING AS CORRECTED FOR POPULATION

Showing the trend in building permits, dollar value per capita, and plotted in per cent of a calculated normal. The dollar value is corrected for changes in construction costs.

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the Thomas Devlin Manufacturing Co., Burlington, N. J., as a result of the recent merging of the two companies. The new company will be known as the Thomas Devlin Manufacturing Company. W. V. Daugherty has been named president.

Mueller-Frigidaire Alliance Announced

L. J. Mueller Furnace Co., Milwaukee, has announced that it has entered into an agreement with Frigidaire Corp., Dayton, Ohio, whereby Frigidaire cooling and dehumidifying equipment will be incorporated in the Mueller Climator domestic air conditioning system. The selling and engineering of the systems will be handled by the L. J. Mueller Furnace Company, and deliveries, installations, and servicing of the Frigidaire equipment will be handled by the Frigidaire organization.

Eadie President of New York Engineers

John G. Eadie, of the firm of Eadie, Freund and Campbell, was elected president of the New York Association of Consulting Engineers at a recent meeting of the organization held at the Princeton Club. Alfred J. Offner was elected vice-president, and Alfred L. Jaros, Jr., of Jaros and Baum, was selected as secretary-treasurer.

Flershem and Smythe Address Boiler and Radiator Manufacturers

Restoration of confidence, return of business ethics, and cessation of the present debased practices such as meeting any competitor's price, faking orders, and seeking orders already placed, were remedies prescribed for the boiler and radiator industry by Rudolph B. Flershem, vice-president of the Marine Trust Co., Buffalo, N. Y., addressing the 18th annual meeting of The Institute of Boiler and Radiator Manufacturers, which recently took place at the Hotel Astor, New York.

An excellent talk on time payments was made by F. A. Smythe, assistant vice-president of the Heating and Plumbing Finance Corp., New York. Mr. Smythe advocated that manufacturers place their time payment plan only in the hands of the more responsible dealers.

It was decided at the meeting that henceforth it would be the practice of the industry to render a bill for all replacements of castings broken in pressure systems. It was also decided that a charge of 10% will hereafter be billed and collected for handling returned goods. The matter of cash discount was discussed with the result that the discount on boilers and radiators will be 5%, 15 days, except in those cases where customers discount twice a month. This provision will be rigorously observed, it is stated. Edwin W. Smith was reelected chairman of the organization.

Home Modernization Exposition Postponed Until May

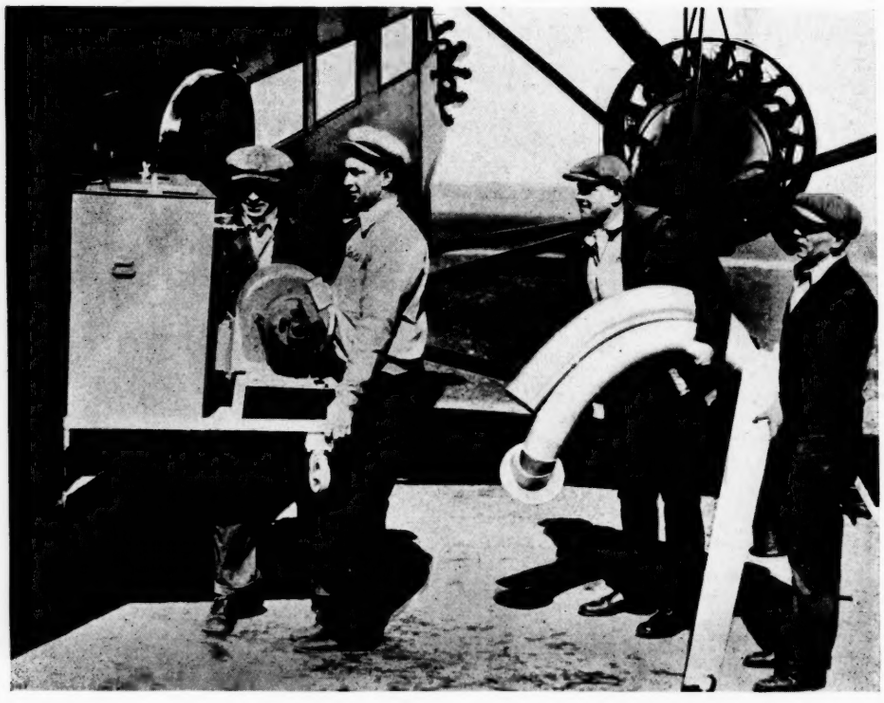
Previously scheduled for the last week in March, the National Modernize Your Home Exposition has been postponed until May 16-20, when dealer and contractor associations in all branches of the building industry will exhibit the latest in construction materials and methods, and home appliances at Madison Square Garden, New York. The later date was decided upon to permit a more complete organization of plans for a concentrated modernization sales drive calculated to stimulate public interest in home rehabilitation.

New International Heater Officers

At its recent annual meeting the International Heater Co., Utica, N. Y., elected the following officers and directors for the coming year: president, J. A. Danquer; vice-president, L. R. Taylor; secretary-treasurer, I. L. Jones; assistant treasurer, R. L. Griffiths; assistant secretary, H. A. Chester. Directors, W. T. Baker, Beecher M. Crouse, J. A. Danquer, I. L. Jones, J. F. Hubbel, Edward Norris, and L. R. Taylor.

Oster-Williams Offers Shop Equipment Check Sheets

Williams Tool Corporation and The Oster Manufacturing Co., Cleveland, manufacturers of pipe threading equipment, have devised a check sheet for the use of master plumbers and heating engineers in making systematic surveys of their threading equipment in line with suggestions offered by the National Com-



IIg blower is part of oxygen apparatus rushed to Miami from Chicago by plane in a vain attempt to save Mayor Cermak's life.

mittee on Industrial Rehabilitation. Worn out or obsolete tools and antiquated methods are expensive to plumbers and steamfitters even under present conditions, and this waste will grow as business volume increases and competition becomes keener.

Provision is made on the sheet for checking present methods against accepted best modern practice, for checking the condition and suitability of stocks and dies, and for a similar analysis of power pipe machines. Sheets will be supplied by the companies upon request.

General Air Conditioning Co. Formed

Formation of the General Air Conditioning Co., Inc., 155 East 44th St., New York, was announced early in March. The president, M. Hitchen, and vice-president, A. H. Clogston, were formerly executives of the Cooling & Air Conditioning Corporation. David H. Knowles is secretary of the new organization.

The company will offer complete engineering service in design and installation of industrial air conditioning, air cooling, and drying systems.

Air Conditioning Corporation to Represent G. E.

The Air Conditioning Corp., 221 North La Salle St., Chicago, has been appointed the General Electric air conditioning dealer in Chicago. C. J. Bassler is president of the company.

"Certified Installations" Explained to Chicago Oil Burner Group

"Certified Oil Burner Installation," a plan recently adopted by the Chicago Oil Burner Association, Inc., was announced to the industry at a dinner meeting of that organization at the Lake Shore Athletic Club, February 23. W. A. Matheson, Williams Oil-O-Matic Heating Corporation, president of the association, introduced the plan and explained its functions and scope.

Mr. Matheson said that representatives of oil burner companies would carry with them, in addition to literature advertising the plan, certification cards identifying them with the plan, the association, and the company represented. Upon completion of an installation, the association would send a certificate to the owner, certifying that the installation was made by a member of the association according to specifications and standards approved by the association, and also stating that the oil burner and equipment was approved by the Underwriters Laboratories.

It is the purpose of the plan to create in the mind of the buying public a greater confidence in the oil burner industry, and to establish a feeling of safety and assurance of satisfaction in the purchase of an oil burner.

Engineer Talks on Air Conditioning to St. Louis Groups

Edwin A. Jones, gas heating and air conditioning engineer, L. J. Mueller Furnace Co., Milwaukee, addressed a luncheon meeting of the St. Louis Electrical Board of Trade, February 7, on the subject "Heating and Humidification." On the evening of the same day, Mr. Jones spoke before an open meeting of the St. Louis Chapter, A.S.H.V.E.

McAlear Appoints 12 Representatives

The McAlear Mfg. Co., Chicago, has appointed 12 representatives, among whom are: Geo. W. Skavish, 3235 38th St., N.W., Washington, D. C.; W. A. McLean, 337 South High St., Columbus, Ohio; J. C. Ross & Co., 2719 First Ave., S., Seattle, Wash.; Stanley Sales Co., 1440 Broadway, New York; Ritts Co., 609 Linwood Blvd., Kansas City, Mo.; Harry S. Bastian, 609 Railway Exchange Building, Portland, Ore.

A. S. H. V. E. Emergency Dues End in 1934

Secretary A. V. Hutchinson of the American Society of Heating and Ventilating Engineers tells us that in the report of the Cincinnati annual meeting of the society, which appeared in our March issue, one statement was slightly in error and might be misinterpreted. The report

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of the meeting as printed implied that the Council had been empowered to fix dues after the end of the year 1934. As a matter of fact, he informs us, the Council was authorized by vote as an emergency measure to set dues up to the end of 1934, but not thereafter.

Smoke Abatement in Jersey Effects Savings

Reclamation of the community as a residential location, in addition to a saving of many thousands of dollars resulting from more efficient combustion of fuel and from reduced property damage, are shown in the 1932 annual report recently issued by the Department of Smoke Regulation, Hudson County, New Jersey.

This work is being carried on under the direction of Col. E. H. Whitlock, in charge of research, and William G. Christy, who directs a staff of practical engineer-inspectors engaged in educating fuel users on smokeless combustion. The report indicates that these inspectors have made a total of 9121 visits to offending stationary plants, railroads, floating power plants, portable equipment, and open fires to investigate apparatus and advise repairs and redesign where necessary to obtain efficient and smokeless combustion.

A reduction of 80% in the smoke nuisance has been achieved through two years of work in Hudson County. A conservative estimate has indicated a saving of $187,000 in conserved fuel accruing to the fuel users as a result of smoke abatement. This does not take into consideration the saving, many times greater, which has resulted from a reduction in property damage and loss caused by smoke-polluted air, and the improved health of the community.

Kohler Opens New Philadelphia Warehouse

Kohler Co., Kohler, Wis., has more than doubled its former warehouse facilities in Philadelphia by the opening of a one-story brick

building at F and Atlantic Streets.

A large line of the company's equipment, including boilers and radiators, will be carried in stock. The company's showroom and branch office remain at 17th and Sansom Streets.

Wet Roofs To Cut Refrigerating Load Suggested by Engineer

Addressing the New York Section, National Association of Practical Refrigerating Engineers, at its meeting held February 17, C. H. Herter recommended wetting the roof surfaces of comfort-cooled buildings and cold storage houses to reduce the load on the refrigerating equipment on hot summer days. Evaporation from the wet surface will lower the surface temperature 5° or more below that of the atmosphere, thus diminishing the inflow of heat, according to Mr. Herter, who stated that the evaporation of 1 gal. of water in this way is equivalent in cooling effect to the melting of 60 lb. of ice. A perforated pipe can be installed along the ridge or high point of a roof so as to keep it wet with a thin film of water.

Hart, Cooley, Highton Co. Formed

The Hart & Hutchinson Company and the Wm. Highton & Sons Division of Hart & Cooley Manufacturing Company have been consolidated under the name of The Hart, Cooley, Highton Company, with main offices in New Britain, Conn.

G. E. Appoints Pflugradt

Pflugradt Co., 215 West Kilbourn Ave., Milwaukee, has been appointed the General Electric air conditioning dealer in Milwaukee, to handle the company's complete line of air conditioning equipment.

Morse New President of American Blower

Clark T. Morse, formerly vice-president of the American Blower Corp., Detroit, was elected president

Clark T. Morse

of that organization. James Inglis was made chairman of the board, F. R. Still, vice-president in charge of export, and Rawson Vaile, secretary and treasurer.

Berryman Broadcasts on Tax Reform

Speaking in favor of a general sales tax to supplant the present method of procuring funds for the financing of government by levying on property and income, J. B. Berryman, president of Crane Co., Chicago, in a radio address over an N.B.C. network, March 11, pointed to the extent which the building industry, directly and indirectly employing more labor than any other excepting agriculture, has been stifled by the shadow of constantly rising taxes. Mr. Berryman's talk was particularly directed to the overwhelming majority of the nation's population who, because they own no real property and because their income is below the taxable minimum, are not taxed directly, and hence they are not sharply conscious that they are paying taxes.

Hidden in the purchase price of each article of food, clothing, and other commodities bought by these people, as well as in the rent paid for living quarters, is an important contribution to meet the cost of government, and it is the voice of this vast majority of our people that is needed to bring about government economy and taxation reform. With a general sales tax, according to Mr. Berryman, taxes are levied on the basis of expenditures rather than on the results of thrift, and a knowledge of the extent to which they are taxed is brought home to the citizen. It would be a most equitable arrangement because the tax would run in proportion to spending.

A reduction of taxes on real property would help to open up a large market in home building in which everyone would participate, Mr. Berryman stated.

Independent Air Filter Moves

The Independent Air Filter Company has moved to larger quarters at 215 West Ohio St., Chicago.

NEW CATALOGS

The Foxboro Co., Foxboro, Mass., has issued Bulletin No. 169-1, describing its line of recording thermometers. Construction details are explained and applications illustrated; standard size, 48 pages.

The Diamond Rubber Co., Inc., Akron, Ohio, has issued its new "Buyer's Guide to Mechanical Rubber Goods." Sections contain data and illustrations descriptive of rubber belting, rubber tubing, and valves and packings; standard size, 24 pages.

Acme Asbestos Covering & Flooring Co., Chicago, has issued a catalog describing its line of heat insulation products. Pipe coverings, boiler insulation, building insulation, underground conduits, stack linings, and insulating cements are included; standard size, 16 pages.

Detroit Lubricator Co., Detroit, Mich., has issued Bulletin No. 60, describing the No. 250 control switch for refrigeration systems. Pressure, temperature, and dual models are included; standard size, four pages.

Harry G. Nye

Harry G. Nye, head of the Nye Tool & Machine Works, Chicago, died February 8, at the age of 60.

Starting in business in 1904, Mr. Nye rapidly expanded his pipe threading dies business to include a complete line of plumbers and steamfitters hand tools and electrically-driven pipe threading machinery.

William A. Pope

William A. Pope, president of William A. Pope Co., Chicago, died at Palm Springs, Calif., February 17, at the age of 66.

Mr. Pope installed the piping in the Commonwealth Edison power houses in Chicago, and many other large installations in this country and South America.

A charter member of the Illinois Chapter, A.S.H.V.E., Mr. Pope was also a member of the Heating and Piping Contractors National Association, the Chicago Master Steamfitters Association, and a director of the Sloan Valve Company.

Guy Knowlton Sembower

Guy K. Sembower, secretary of Orr & Sembower, Inc., Reading, Pa., died recently at his home in Wyomissing Hills, Pa., at the age of 44. He is survived by his widow and three children.

Correspondence

Calculations on Steam Ejector Cooling

EDITOR, HEATING AND VENTILATING:

It would seem that comment is in order regarding the article, "Engineering Calculations and Costs of Operation," appearing on page 25 of the February issue of HEATING AND VENTILATING.

On pages 26 and 27 calculations are shown determining the area of the throat and proportions of the whole nozzle for the passage of 1200 lb. of steam per hour with an initial pressure of 100 lb. gauge per square inch and a secondary or discharge pressure 0.3 in. mercury absolute.

It is true that, where the discharge pressure is 58% of the initial pressure or less, the pressure at the point of greatest constriction of a nozzle or at (or very close to) the orifice (if thin plate) is, theoretically, always about 58% of the initial pressure. However, this is true only if all pressures are taken as absolute and not gauge as is done in the article.

In the subject problem, therefore, the initial pressure is 114.7 lb. per sq. in. absolute and the pressure at the area of greatest constriction of the nozzle is 58% of 114.7 lb., or 66.5 lb. absolute (i.e., 51.8 lb. per sq. in. gauge).

The conversion of heat into kinetic energy in the expansion of any gas, i.e., the heat which is necessary in order to give velocity to the gas, is obtained from the gas itself by its adiabatic expansion, which is to say, at constant entropy. Therefore, in the subject problem we can, either by calculation or by using steam table charts such as Mollier diagrams, determine the following:

H_p, total heat of saturated steam at the initial pressure of 114.7 lb., is found to be 1188.8 B.t.u. and the entropy 1.591.

H_{pc}, the total heat at the throat of 66.5 lb. absolute pressure and 1.591 entropy is found to be 1146 B.t.u. with a specific volume of 6.25 cu. ft. per lb.

The available heat for conversion to velocity is, therefore, 1188.8 minus 1146 = 42.8 B.t.u.

The velocity, $V = 223.7\sqrt{43.8}$ B.t.u. $= 223.7 \times 6.54 = 1462$ ft. per sec. and the area

$$= \frac{1200 \times 144 \times 6.25}{3600 \times 1462} = 0.205 \text{ sq. in.}$$

Likewise, the mouth of the nozzle at P_e will have an area determined as follows:

Total heat at 0.3 in. mercury absolute and 1.591 entropy = 803 B.t.u. with a specific volume of 1507 cu. ft. and the available heat = 1188.8 minus 803 = 385.8 B.t.u., giving a velocity of 4393 ft. per sec. The area, therefore, will be 9.85 sq. in.

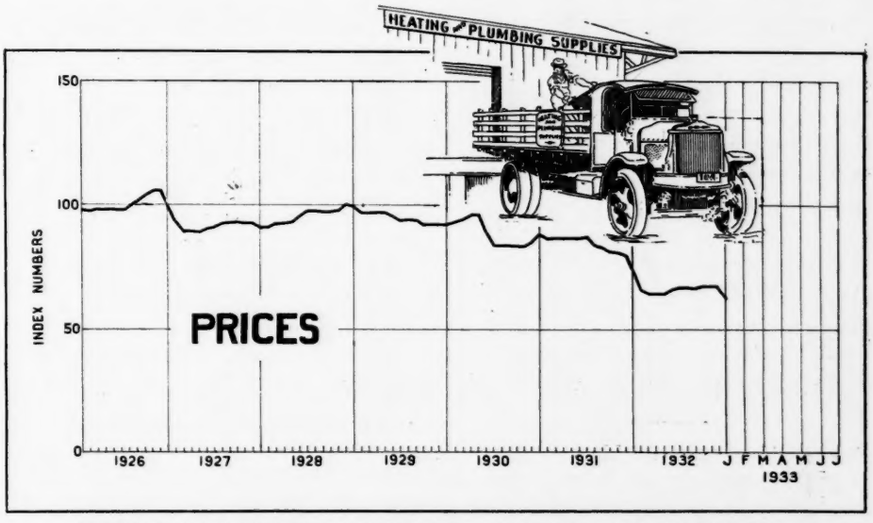
Nozzle losses may be expressed in terms of energy, velocity, or a factor representing the ratio of actual to theoretical flow of steam in pounds per hour. If, in this problem, a loss of 10% in velocity is effected, as stated by the author, this would mean a throat velocity of 1318 ft. per sec., equivalent to 34.5 available B.t.u. and the difference between 42.8 and 34.5, or 8.3 B.t.u., will reheat the steam giving it a H_p of 1146 plus 8.3 = 1154.3 B.t.u. which, at 66.5 lb. absolute would show a specific volume of 6.35 (the entropy having increased by this reheating action to 1.604) and the throat area then should be

$$\frac{1200 \times 144 \times 6.35}{3600 \times 1318} =$$

0.232 sq. in., so that the author's nozzle of 0.5 sq. in. area will pass 2600 lb. of steam per hour instead of 1200 as desired.

The mouth of the nozzle would be affected in similar manner which can be calculated as above.

It might be remarked that such



TREND OF WHOLESALE PRICES, HEATING AND PLUMBING

Wholesale prices of heating and plumbing materials dropped sharply in January to 62.8% of the 1926 average. The index for February, not shown on the chart, stands at 59.4, another marked decline.

Correspondence

a loss of 10% in velocity equivalent to a loss of 19% in available B.t.u. or, of 11½% in weight of steam passed would hardly be good practice, an energy loss of about 10% in available B.t.u. equivalent to a velocity loss of some 5% or 6% being more in reason.

New York, N. Y. M. T. M.

The above comments are appreciated by the author and may serve as information to those interested in the fine points of design, as well as a correction in general. The author of the article is not familiar with the fine points of design, but merely gave an outline of the many details to be considered and meant to make the article quite general. All the information was taken from his own theoretical knowledge of turbine design and from technical handbooks on this subject. The error of not using absolute pressures throughout for the calculations was an oversight. J. F. Kooistra

Carrier Engineering Corp. of California, Los Angeles.

Readers' Comments on High Humidity in Gas-Heated Homes

[The following comments from readers relate to Question 73, together with the answer, published in "Your Everyday Problems," page 42 of the March, 1933 issue. The question was concerned with the condensation of moisture on the windows of a well-constructed, gas-fired, warm-air, furnace-heated house with relative humidities running from 35% to 40%. The answer suggested as a possibility the removal of the weatherstripping to allow some outside air to circulate through the house so as to mix the relatively dry outside air with the moist inside air, thus reducing the humidity below the dewpoint and eliminating the condensation on the windows.]

Editor, Heating and Ventilating:

My interest in the progressive and educational articles which continually appear in your magazine leads me to make the following suggestion in regard to your answer to Question 73 appearing in the March issue.

The problem outlined in Question 73 is identical with one experienced by our company this winter. Our customer, also, had a gas-designed, warm-air furnace properly installed and operating by gravity circulation. The construction of the house was good, all windows and doors were weather-stripped, and there was a fireplace located in the main living room of the home. The fireplace chimney was combined with the furnace chimney, there being two separate tile-lined passages of standard construction, one for the furnace and one for the fireplace. This chimney was located on the outside of the home.

Even with the humidifying pan not in operation, the relative humidity in the living quarters in the home ranged from 38% to 43% with all windows and doors closed. Use of the fireplace and additional ventilation failed to correct the condensation of the moisture on the window-panes to the customer's satisfaction. Of course, we explained to the customer the desirability of maintaining a minimum humidity of around 40% for the most healthful living conditions and suggested the use of storm-windows to prevent the condensation. However, the customer had friends whose homes were heated with similar equipment and who were not bothered with this condensation problem. On testing the humidity in one of these homes, I found the relative humidity to be about 19% when the outside temperature was 10° above zero which, of course, explained why this house had no condensation on single-pane windows.

After exhausting the methods outlined in your answer, and still failing to satisfy our customer, we were finally forced to remove the gas furnace and the customer installed a coal-burning furnace which immediately corrected the condensation troubles by reducing the humidity to a very low point.

The gas furnace was examined carefully and the combustion chamber and radiator found to be in a gas-tight condition and a standard back-draft diverter was used during the entire time the furnace was in operation.

In analyzing the problems encountered and the factors taken to correct them, assuming that it is desirable to meet a customer's demands of providing humidities as low as 19%, I have come to the following conclusions upon which I will appreciate your criticism.

The gas furnace was operated with an off-and-on thermostat which placed the furnace in operation at its full-rated capacity until the thermostat was satisfied and then cut off all fuel except a small pilot light. During the period in which the furnace was not in operation, the outside chimney was chilled and all draft up the chimney stopped because the air in the chimney became colder than the air in the home. Then when the gas was turned on at the full capacity of the furnace, there was a short period during which the chimney was being heated when there was insufficient draft to carry the products of combustion out of the house and a certain part of these products of combustion was, therefore, forced into the basement and later made its way into the entire home. Since perfect combustion was obtained, no odor of any sort was noticeable and the only evidence of this condition was the moisture content of the home. This conclusion is substantiated by two factors which appear in my notes concerning this installation. The first was that the basement humidity usually ran about 2% higher than the humidity in the living quarters. The other was that

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COMING EVENTS

JUNE 6-8, 1933. National Warm Air Heating Association Convention, to be held in Chicago, Ill. Headquarters at the Stevens Hotel.

JUNE 12-17, 1933. Tenth Annual Convention of the American Oil Burner Association, to be held in Chicago. Headquarters at the Hotel Stevens.

JUNE 19-22, 1933. Fifty-First Annual Convention and Exposition of the National Association of Master Plumbers, to be held in New Orleans, La.

JUNE 25-30, 1933. Sixth Midwest Engineering and Power Exposition, to be held in Chicago.

JUNE 27-30, 1933. Twenty-Fourth Annual Convention of the National District Heating Association, to be held in Chicago. Headquarters at the Palmer House.

JULY 25-28, 1933. Annual Convention of the Heating and Piping Contractors National Association, to be held in Chicago.

on one occasion when the furnace had been out of operation for about an hour, a slight back-draft was noticeable when the furnace began operating.

As to the solution of the problem in this particular case, I believe that a high-low operation of the thermostat instead of an off-and-on operation of the thermostat would have maintained a sufficient temperature in the chimney at all times to provide a uniform draft and, therefore, prevent periodic back-draft or periodic periods of no draft and thus prevent products of combustion containing a high-moisture content from entering the home.

Editor's Note: The argument seems to be logical from the analysis of the case. Certainly it presents the possibility of a solution not mentioned in the previous answer. The case quoted seems to be an extreme one and there is no way of knowing how the proposal would have worked out. Where such extreme humidities occur one cannot help suspecting that there must be sources of moisture present which are outside the heating apparatus and that the possibility of controlling or modifying them should be looked into. Perhaps the moisture added by the combustion of the gas was itself only a small part of the total added but was enough to add the undesired excess. If so, it would be just as logical to try to cut down that due to other sources, such as use of kitchen pilots and boiling of water in open pans as to try to eliminate the moisture added at the house-heating apparatus.

EDITOR, HEATING AND VENTILATING:

We have read Question 73 (from the X Co.) and also your answer on page 42 of the March issue of HEATING AND VENTILATING.

There have been occasional cases in Chicago where gas-heated homes experienced conditions similar to those stated in the question. In these cases we have endeavored to determine the cause of the unusual amount of water vapor in the home and in each case we found the high humidity was caused by poor draft or lack of draft (perhaps due to blocked chimney).

As you know, when most kinds of gas burn, a considerable quantity of water vapor is produced as one of the products of combustion. With proper draft conditions the water vapor will be carried quickly out the chimney in gaseous form.

If the products of combustion do not pass freely up the chimney, the water vapor will pass out into the basement through the opening in the draft hood. By diffusion, the water vapor will enter the first floor of the building and we have cases where it has even gone as high as the second floor.

In each of our cases we have been able to solve the difficulty by correcting the draft condition. We believe that if the X Co. will check the draft in addition to the points mentioned in your answer, they will eliminate the difficulty.

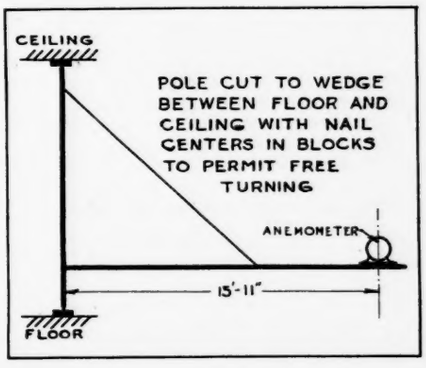
H. B. JOHNS.
Mgr., House-Htg. Div.,
The Peoples Gas Light & Coke Co.,
Chicago.

EDITOR, HEATING AND VENTILATING:

I am appalled at your answer to Question 73, published in your March issue. The moisture condition described in the question is one that most home owners spend a good deal of money to obtain. It is healthy, good for the furniture and furnishings, and therefore economical from the point of view of doctors' bills or furniture repairs. I am overwhelmed by the fact that your magazine, of all magazines, apparently does not recognize this fact, and recommends that the condition be corrected by making the air so dry that there is not enough moisture in it to condense on a cold window pane.

The solution, of course, is to keep the humidity at 35% or 40%—or even 50%, if in any way possible, and then prevent the condensation on windows by the use of storm sash well fitted, or by double panes of glass in the sash, with an air space in between. Both these methods are entirely effective.

VICTOR MORRIS.
Milwaukee, Wis.


CEILING
POLE CUT TO WEDGE BETWEEN FLOOR AND CEILING WITH NAIL CENTERS IN BLOCKS TO PERMIT FREE TURNING
ANEMOMETER
15'-11"
FLOOR

Correspondence

Comments on Field Calibration of Anemometer

EDITOR, HEATING AND VENTILATING:

Mr. Elder's very excellent article on the use of the anemometer in your March issue reminds me of a wrinkle that I have often used in 25 years of inspection work in many states and in Canada for the Herman Nelson Corporation.

Sometimes circumstances make it desirable to calibrate an anemometer quickly in the field where all concerned can be satisfied as to the degree of its accuracy. It can be readily applied in a very little time, and most buildings afford the necessary space and the simple materials.

Moving an anemometer in still air, at a specified rate of speed has the same effect upon the registration of the anemometer as if it were placed in a current of air moving at the same velocity.

A circle for the path of travel of the anemometer that is 100 ft. in circumference can usually be arranged in some basement space, hall, or gymnasium. The only materials required are a pole arranged to wedge between floor and ceiling as sketched, with nail centers in wood blocks to permit the pole to turn freely, an arm to give the required radius for the 100 ft. of circular path, and a wire or cord tie to afford the necessary stiffness to the arm.

The anemometer is secured to the arm at a point that will give the 100 ft. of circular travel as it is swung to the time of a stop watch.

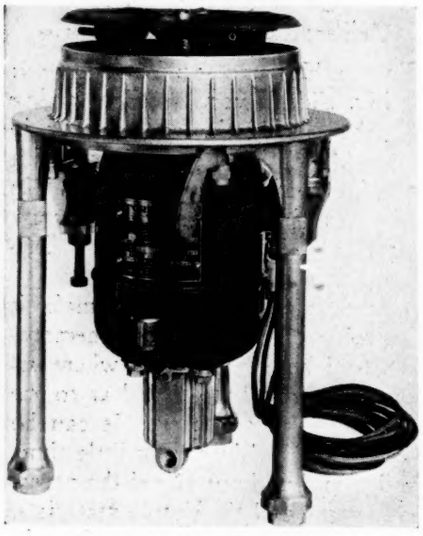
Any other distance permitted by the available space would give the same facility of calibration, as the 100 ft. path, but with a path of 100 ft. the arm may be swung in the desired number of revolutions per minute to correspond to the velocity that the anemometer is desired to measure.

Peoria, Ill. JOHN M. ROBB

New Equipment

Toridheet Burner Incorporates Improvements

Cleveland Steel Products Corp., Toridheet Division, Cleveland, has announced a new Model C wall wiping flame type oil burner, featuring a number of improvements.



Model C Toridheet burner

Motor brackets, adjustable air shutter, adjustable legs, and burner stack are of aluminum die-cast construction. A single phase capacitor motor, designed for vertical operation, drives the burner at 1760 r.p.m. Starting current is 1½ amperes, and the running current is 1/3 ampere. Lubricating oil is supplied to all bearings by wicks held in contact with the motor shaft, and a large reservoir at the bottom of the motor contains sufficient oil for from three to five years of normal operation. A frictionless oil seal, called the Ropeller, is attached to the lower end of the motor shaft.

Distributor fans are supplied in various sizes to meet the requirements of the combustion chamber, each size having a broad range of application.

Temperature and Pressure Relief Valve Protects Tanks and Boilers

J. W. Moore Valve Corp., Everett, Mass., is manufacturing a water relief valve to safeguard boilers and tanks against rupture due to excessive pressure.

Unless otherwise specified, the spring is set to open at 125 lb. pressure, opening and closing automatically at this point. A beveled spring holder results in true longitudinal pressure on the valve seat. The temperature portion of the valve is entirely separate, consisting of a fusible alloy which melts out and relieves the pressure when the temperature of the water reaches the boiling point. An extra fuse is carried in a holder at the side ready for use in case the one in the valve has blown.

Ventilating Air Brought to Motors Through Pipes

A pipe-ventilated motor designed for use in locations where exposed to excessive humidity, high temperature, dust, or other injurious atmospheres, or where totally-enclosed motors have been recommended because of explosive dusts or vapors, has been announced by The Ideal Electric & Manufacturing Co., Mansfield, Ohio.

Motor is a totally-enclosed polyphase induction motor of the squirrel cage type, ventilation being supplied by a large centrifugal fan which draws cool clean air in at one end and discharges the warm air out of the other. The air intake opening is connected to a pipe leading from any convenient source of fresh air and the outlet opening may be left free to discharge into the room or may be piped outside as desired.

These motors are available to meet all requirements from 1 hp. to 200 hp., including induction motors having unity or leading power factors. They are also made in two, three, and four-speed models.

MANUFACTURERS of Air Conditioning Equipment, such as described in our Air Conditioning for Small Buildings Number (October, 1932), and whose equipment was not included in that number are invited to send descriptive material of their product, or proposed product, to The Editor, HEATING AND VENTILATING, 148 Lafayette St., New York.

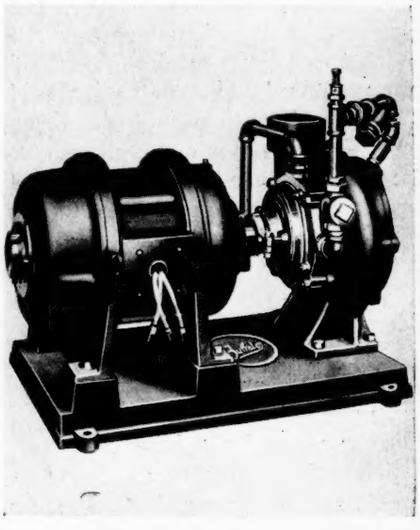
Domestic Stoker Burns Inexpensive Grades of Coal

An automatic stoker designed for burning the small, inexpensive grades of anthracite in residential heating plants, is being marketed by Burnwell Corp., Allentown, Pa.

Coal is prepared for correct combustion with a minimum of moving parts. No grease cups are used, the operating mechanism running in an oil bath. All parts are enclosed in a bright red lacquered cabinet shaped to facilitate easy installation on any type of boiler or furnace. The hopper has an inner removable shell of rust-resisting material, easily replaced when required. Its capacity is approximately 500 lb. of fuel. Thermostatic control is included.

Single Suction Self-Priming Pump

As a companion line to its series of double suction, self-priming pumps, Buffalo Pumps, Inc., Buffalo, N. Y., has brought out a single suction, self-priming pump. This will be known as the Buffalo Type CP.



Buffalo Type CP single suction pump

Casing is of cast iron and suction side plate is template-drilled, with close clearance between it and the impeller. Open type or enclosed type impellers are available in bronze, cast iron, or other suitable metal, to meet the conditions of the

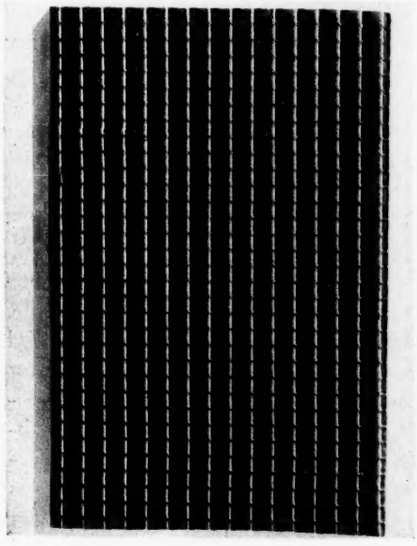
service. Self-priming device is mounted as an integral part of the pump casing. Both pump and primer impellers are carried on the bronze-covered extension of the motor shaft, eliminating pump bearings and coupling. A split type gland, furnished with long wearing packing, is used.

Pump is furnished complete with all necessary fittings. It is built in several sizes up to a capacity of 450 g.p.m., for heads up to 150 ft.

Leather Belting Has Treaded Surface

Leather transmission belting having a ribbed or grooved surface for improving the traction between belt and pulley has been developed by E. F. Houghton & Co., 240 West Somerset St., Philadelphia. This product is being marketed under the name of Vim Tred leather belting.

This grooved tread is produced by indenting part of the surface under pressure, the ribs in contact with the pulleys being the original natural surface of the leather, retaining its wearing and gripping qualities. Concentration of pressure between the belt and pulley results in increased power transmission with greatly reduced slippage and consequent wear. Tendency to sway is



Driving surface of Vim Tred leather belting

prevented by the tracking of the flat ribs on the pulley, and loss of power due to entrapped air or foreign matter between the belt and the pulley is eliminated. The manufacturer states that the natural resiliency of Vim Tred belting, together with its improved traction, render it ideal for drives on which it is necessary to absorb shock loads, since it will take up a shock by elongating and immediately recoil without slipping. It is also recommended by the manufacturer for short center-to-center drives.

Metallic Foil Building Insulation

Reynolds Metals Co., 541 West 25th St., New York, is marketing Master Metal foil insulation for reducing heat transmission through walls and roofs. This material consists of thin flexible sheets of highly polished non-tarnishing metal, reinforced with treated paper.

Insulating qualities of the material result from its high reflectivity and low emissivity of radiant heat, the bright metallic surfaces reflecting 95% of this heat and emitting but 5% according to the manufacturer. To take advantage of this, one or both metal surfaces must face an air space, and this is accomplished by applying the insulation either against the studs, joists, or rafters under the sheathing or plaster base, so that one metal surface faces the air space formed by the framing members, or by applying it midway between the framing members so each metal surface is left exposed.

It is stated by the manufacturer that it has been demonstrated experimentally that with one metal surface exposed the material will provide the same insulating effect as ¾ in. of ordinary insulating board, 12 in. of brick, or 20 in. of concrete. The insulating effect is said to be doubled when two surfaces are exposed. Master Metal insulation is waterproof, windproof, verminproof, and is odorless. It will retain its bright surface indefinitely.

Timing Device Sets Thermostat

A self-winding timing unit for automatically advancing the thermostat setting has been placed on the market by The Econel Corp., 1270 Broadway, New York. The device is mechanical, and requires no electrical connections. It is screwed to the wall beneath the thermostat, as shown, and adjusted so that the operating arm will move the thermostat indicator to the desired position when the arm is in its extreme position. This is done by means of the adjusting screw at the top.

When the thermostat is set back at night, or before the premises are vacated, the timing knob is turned to the point corresponding to the

Econel control installed with thermostat

number of hours before heat will again be desired and the mechanism is set by pushing the toggle lever at the bottom to the right. When the time has elapsed, the thermostat will have been pushed ahead to the desired point.

Kitchen Ventilating Fans Are Reversible

A completely redesigned line of ventilating fans for the home kitchen has been announced by Emerson Electric Mfg. Co., 2018 Washington Ave., St. Louis, Mo. They are available in 9 in., 12 in., and 16 in. sizes, the smaller two of which are reversible to permit change-over from exhaust to intake operation at any time, by throwing a switch.

Rubber bushings are used in the four mounting supports to insure quietness of operation. Motors are fully enclosed and dustproofed, and are said to run for at least a year without re-lubrication.

Adjustable wall boxes, to fit any wall thickness, provide for permanent built-in installation of the fans. These are constructed of heavy,

rust-resisting steel, electrically welded, and finished in gray lacquer. The wall boxes are weather tight, and require no wood frame work when installed during construction of house. Mounting panels for window installations are also manufactured. These may be had either all metal, or with translucent inserts to reduce interference with the light.

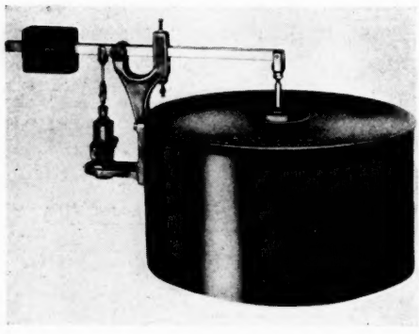
Draft Control for Improving Combustion

Heat & Draft Controls, Inc., 582 The Arcade, Cleveland, is marketing the D-C Fuel Saver draft control unit, a device for improving combustion and utilization of heat in coal, oil, and gas-fired equipment in sizes suitable for domestic, commercial, and industrial installations.

This appliance consists of a section of pipe having a ring of air vents, or louvers, around its exterior and a cone-shaped baffle within. It is inserted into the smoke pipe as close as possible to the heating unit, and the gases of combustion traverse it in passing to the chimney. The manufacturer states that the device eliminates faulty combustion due to insufficient air supply, and prevents wasteful oversupply of air. It also prevents back-draft on gas appliances.

Furnace Draft Regulator for Tall Buildings

Carrick Engineering Co., 431 South Dearborn St., Chicago, is manufacturing the Carrick draft regulator, a device for automatically adjusting and maintaining the furnace draft to meet the conditions of maximum combustion efficiency. The manufacturer recommends it for both oil- and coal-fired boilers in high buildings, where stacks are necessarily higher than required to provide the correct draft.



Carrick hydraulic furnace draft

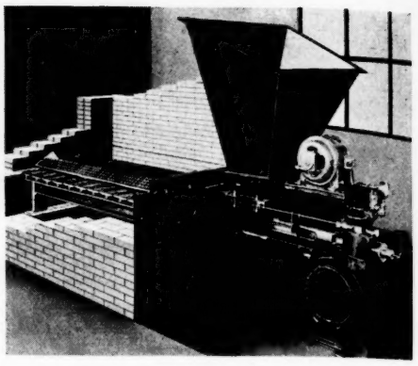
Regulator consists of an inverted bell suspended from a beam and counter-balanced by an adjustable weight. The bell is sealed in oil, and a connection is made from underneath the bell to the furnace. As the pressure varies beneath the bell, due to fluctuations of the static pressure within the furnace, the motion imparted to the beam is transmitted to operate a four-way valve which controls a hydraulic pressure applied to the top and bottom of a double-acting hydraulic piston. This piston may be connected to a damper, governor, valve, switch, or any other means of controlling air supply or fan speeds. When the regulator piston reaches the balanced position, the four-way valve closes, shutting off the power and causing the piston to remain in one position. Regulators are available also in an electrically-operated model.

Large Stoker is Hydraulic-Driven

For large and intermediate heating loads The Patterson Foundry & Machine Co., East Liverpool, Ohio, has announced the Standard hydraulic stoker. This line is built in a wide range of sizes and the manufacturer recommends it for installations requiring capacities of from 50 hp. to 150 hp., but states that ample flexibility is provided to allow for overloads up to 125%.

These stokers utilize the underfeed principle, the ram piston being operated by oil under pressure. The motor is mounted on top of the oil reservoir which acts as a supply and overflow chamber, and drives, through a V-belt, a small rotary pump submerged in the reservoir which provides pressure to operate the hydraulic ram through a slide valve and regulating valve. By means of this regulating valve, ram speeds can be adjusted from standstill to several strokes per minute, and an adjustment on the distributing rod varies the distribution of coal in the retort.

Grate area is made up of sloping slot-type tuyeres and slotted side dump bars, with a plenum chamber beneath divided into zones with



Patterson hydraulic stoker

damper control. Hoppers are hinged to tip either way and are provided with access doors near the bottom. The same stoker is available with a separate fan motor, or with the fan V-belt driven from the same motor that drives the pump. Gear-driven stokers are also built in similar sizes.

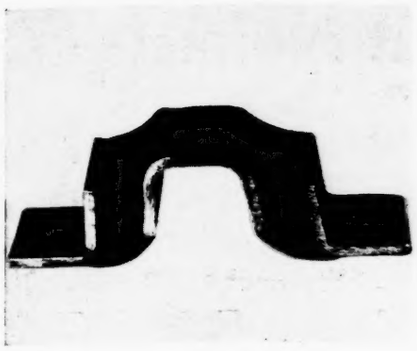
Rubber Vibration Dampeners

Firestone Tire & Rubber Co., Akron, Ohio, has developed a line of vibration dampening machine mountings employing a rubber-to-metal adhesion construction.

Recommended for oil burners, stokers, refrigerating equipment, and ventilating fans and blowers, the Firestone cushion connector consists of a cylindrically-shaped rubber insulator having attaching bolts set in each end. The connector will carry its load in compression, tension, shear, or torsion, and completely breaks the metallic connection between the vibrating load and its support. They are manufactured in three grades of rubber hardness to meet various conditions.

For heavier loads the Firestone vibration dampener is applicable. In this case the load is carried on an inverted U-bar, supported by blocks of rubber bonded to the U-bar and two angle strips. The rubber is subjected primarily to shearing stress when the mounting is placed beneath the leg or base of a machine, although it can be applied in arrangements where the machine is suspended from the mounting, in which case a transverse load is carried on the rubber.

This insulation is made in lengths of 12 in., 24 in., and 36 in., in three grades of rubber hardness, and charts supplied by the manufacturer



Firestone vibration dampener

enable the user to determine the correct length and corresponding grade of rubber stock to meet his conditions.

Compact Humidifier Announced

Air-Control Systems, Inc., 2240 North Racine Ave., Chicago, has announced the Zephyr 50, a compact, portable humidifying unit for home or office use.

Air is drawn into the rear of the cabinet by a motor-driven fan, circulated through a copper washer chamber, and discharged back into the room through a grille in the top. Water is introduced into the air in the chamber by a spray atomizer, and the stream of humidified air is passed through eliminator plates to remove excess moisture before entering the room. The manufacturer states that the unit is suitable for summer cooling and dehumidification when refrigerated water is supplied to the spray. Waste water, containing the dust washed from the air, flows out a pipe connection at the bottom.

Peerless Furnace Blower

A furnace blower and filter unit, the Peerless Duplex furnace blower, has been announced by The Peerless Electric Co., Warren, Ohio.

Blower wheels are mounted directly on the double extended shaft of a Peerless capacitor type motor, obviating the use of a driving belt. Interchangeable panels, top and rear, make it possible to take air in at either part of the unit. This facilitates summer cooling by providing the means whereby the return house air may be mixed with the cool basement air. There are 800 sq. in. of filter area, providing sufficient capacity for supplying filtered air in the home even when the blower is not operated.

This unit has a range of capacities from 575 cu. ft. per min. to 1200 cu. ft. per min. at ⅛ in. static pressure. A control box permits the selection of any one of seven speeds to provide proper air capacity for any given installation.

Machine Mountings Use Rubber in Shear

Lord Manufacturing Co., Erie, Pa., has announced a line of bonded rubber shear-type vibration absorption machine mountings. Among the applications are air conditioning equipment, fans and blowers, refrigeration equipment, and electric motors.

In these mountings, which are available in a wide variety of forms, resilient rubber has been bonded to metal attaching members so that the rubber carrying the load is subjected to shearing stress. The manufacturer claims that rubber in shear results in a soft rate of deflection and provides a low natural frequency with compact construction. An initial tension is imparted to the rubber by the mounting, giving a characteristic of being many times as stiff radially as axially. This permits a suspension that is comparatively stable in any desired direction, and extremely soft and with a low natural frequency in the direction of the vibratory thrusts. At the same time, the internal friction of the rubber effectively reduces the amplitude at resonance and damps out repeated oscillations to a great extent.

Electric Resistance Welded Boiler Tubes

Steel and Tubes, Inc., subsidiary of Republic Steel Corp., 224 East 131st St., Cleveland, has announced development of electric resistance welded boiler tubes, to be marketed under the name Electrunite.

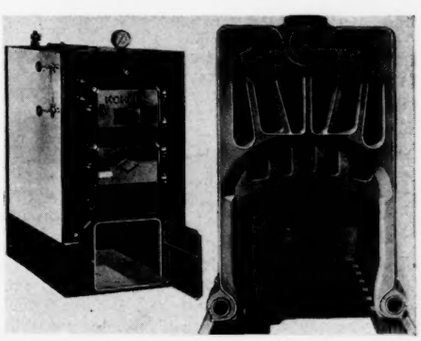
These tubes are formed from strip steel continuously, the strip being passed through a series of forming rolls and the round butted tube thus formed passed under revolving wheel-like electrodes. Pressure is applied as the current passes across the butted seam, and the heat which is below the fusion temperature and confined to a very small area, completes the weld. The tubing is then normalized and tested. This process results in a tube of uniform diameter and wall thickness, presenting a fine strip steel surface inside and outside. All sizes up to 5 in. outside diameter are available in copper bearing steel, nickel steel, and Toncan iron, as well as in the usual open hearth steel.

Kohler Announces Oil or Gas-Fired Boiler

Details of the recently announced series H18 inch water tube boiler for oil and gas-firing, manufactured by Kohler Co., Kohler, Wis., reached us too late to be included in the tabulated listings in the foreward part of this issue.

This boiler is of the rectangular sectional cast-iron type, having several distinctive features of design. Interior sections have six flue-ways which, when assembled form four foreward and two return passages. Each interior section has also a deeply suspended direct heating surface over the oil or gas burner. The boiler is encased in a heavy gauge steel jacket finished in red, top and sides, with black front and back. Trimmings are nickel-plated.

Boilers are available in six sizes, ranging in capacity from 495 sq. ft. to 970 sq. ft. of direct steam radiating surface, recommended load. While the manufacturer does not recommend this equipment for hand-firing with solid fuels, it can, in case of necessity, be equipped with suitable grates and shaking bars for anthracite coal.



Section of Kohler oil and gas-burning boiler

February Degree Days About Normal—Season's Total Running Above Last Year

February, 1933

FUEL bills for oil, gas, coal, and street steam used for heating buildings are probably running considerably above those of last year, according to the totals of degree day figures for all but three of the cities reported on these pages. The whole country, with the exception of the Pacific coast, is experiencing a colder winter than was the case in 1931-32.

The column to the right shows the percentage increase or decrease in the degree day totals for the present heating season as compared with last year. The data are for the heating season up to March 1.

With the exception of the Southern cities, the greatest increase is shown by Louisville, Indianapolis, Cincinnati, St. Louis, Baltimore, and Boston. Seattle shows a 3.2% decrease, while the other far-western cities show a more marked decline from last year. New York is running 16.8% above last year, Chicago 29.5% above, and Philadelphia 24.0% above.

As compared with normal (fifty-year averages), the only cities having a relatively cold winter are Boston, Denver, Memphis, San Francisco, and Seattle.

In spite of the cold wave which swept the country in February, the degree day totals were not markedly affected to the extent of greatly influencing the seasonal totals. For 17 of the cities reported, February itself showed totals about normal, one markedly above normal (Seattle) and six—Baltimore, Boston, Buffalo, Cleveland, New York, and Philadelphia —actually below normal.

Degree day figures for February, together with cumulative totals for the present season, last season, and normal are shown below, as are the unit fuel consumption data for the month of February.

(Percentages below indicate increase or decrease in degree days this year compared with last)

EAST	
New York	+ 16.8%
Philadelphia	+ 24.0
Boston	+ 32.2
Buffalo	+ 17.1
Baltimore	+ 33.1
Pittsburgh	+ 25.4
MIDDLE WEST	
Chicago	+ 29.5%
St. Louis	+ 38.4
Kansas City	+ 27.8
Minneapolis	+ 20.4
Cincinnati	+ 35.2
Cleveland	+ 17.6
Detroit	+ 26.2
Indianapolis	+ 39.4
Louisville	+ 44.6
Des Moines	+ 22.8
SOUTH	
New Orleans	+ 138.8%
Atlanta	+ 52.3
Birmingham	+ 64.3
Memphis	+ 60.0
FAR WEST	
Denver	+ 10.0%
Seattle	— 3.2
San Francisco	— 14.9
Los Angeles	— 20.0

Degree Days and Unit Fuel Consumption—February, 1933

	Atlanta	Baltimore	Birmingham	Boston	Buffalo	Chicago	Cincinnati	Cleveland
Degree days for Feb. 1933	579	758	508	874	991	1086	862	949
Degree days, Sept. 1, 1932 to Feb. 28, 1933	2247	2980	1997	3568	4252	4393	3633	3867
Degree days, Sept. 1, 1931 to Feb. 29, 1932	1476	2239	1215	3457	3632	3386	2687	3288
Degree days, Sept. 1 to Feb. 28, Normal	2371	3462	2079	3280	4767	4582	3666	4440
Lb. coal per sq. ft. rad., Feb. 1933	4.632	6.064	4.064	6.992	7.928	8.688	6.896	7.592
Gal. oil per sq. ft. rad., Feb. 1933	0.397	0.520	0.348	0.599	0.680	0.745	0.591	0.651
Cu. ft. gas per sq. ft. rad., Feb. 1933	55.58	72.77	48.77	83.90	95.14	104.26	82.75	91.10

	Denver	Des Moines	Detroit	Indianapolis	Kansas City	Los Angeles	Louisville	Memphis
Degree days for Feb. 1933	998	1139	1055	952	919	249	780	621
Degree days, Sept. 1, 1932 to Feb. 28, 1933	4411	4916	4408	3966	3806	940	3270	2511
Degree days, Sept. 1, 1931 to Feb. 29, 1932	4008	4004	3495	2929	2978	1178	2332	1569
Degree days, Sept. 1 to Feb. 28, Normal	4273	4935	4719	4099	4216	1016	3327	2470
Lb. coal per sq. ft. rad., Feb. 1933	7.984	9.112	8.440	7.616	7.352	1.992	6.240	4.968
Gal. oil per sq. ft. rad., Feb. 1933	0.684	0.781	0.723	0.653	0.630	0.171	0.535	0.426
Cu. ft. gas per sq. ft. rad., Feb. 1933	95.81	109.34	101.28	91.39	88.22	23.90	74.88	59.62

	Minneapolis	New Orleans	New York	Philadelphia	Pittsburgh	St. Louis	San Francisco	Seattle
Degree days for Feb. 1933	1358	227	872	794	894	839	384	769
Degree days, Sept. 1, 1932 to Feb. 28, 1933	5892	963	3375	3039	3698	3456	1838	3332
Degree days, Sept. 1, 1931 to Feb. 29, 1932	4887	404	2889	2453	2950	2497	2159	3442
Degree days, Sept. 1 to Feb. 28, Normal	5950	965	3870	3629	3947	3652	1770	3309
Lb. coal per sq. ft. rad., Feb. 1933	10.864	1.816	6.976	6.352	7.152	6.712	3.072	6.152
Gal. oil per sq. ft. rad., Feb. 1933	0.931	0.156	0.598	0.544	0.613	0.575	0.263	0.527
Cu. ft. gas per sq. ft. rad., Feb. 1933	130.37	21.79	83.71	76.22	85.82	80.54	36.86	73.82

Fuel consumption figures given above are based on certain conditions, and for other conditions corrections must be made. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operating at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal, 1000 B.t.u. per cu. ft. for gas, and 140,000 B.t.u. per gal. for oil. To correct for other heating values, efficiencies, and design conditions, follow the method explained in the "Heating and Ventilating Degree Day Handbook."

Hawthorne Intermediate School
Elmhurst, Illinois

E. Norman Brydges, Architect
Chicago and Elmhurst

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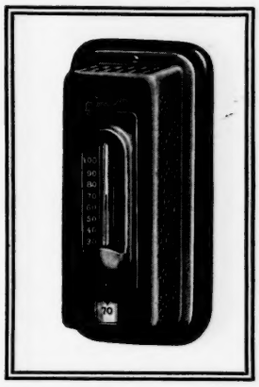
• • • THE ORIGINAL UNIT of the school building pictured above was built in 1919 and heated by a "direct blast" system. Johnson automatic heat regulation was installed to operate mixing dampers at the double plenum chamber, mixing hot and tempered air as required for each room.

In 1926 and 1927, the first and second additions were constructed and are heated by means of a "split" system. Johnson apparatus controls the direct radiators in the rooms and also maintains a uniform temperature in the ducts supplying air for ventilation. The original heating plant was not disturbed.

The third addition, 1929, is heated and controlled in the same manner. When this addition was built, the heating system in the original unit was changed to a split system, and the same Johnson thermostats were arranged to control the new heating apparatus.

In 1932, unit ventilators were installed in the fourth addition. Again the Johnson System was employed, this time to control valves and dampers in the unit ventilators, together with valves on the auxiliary radiators.



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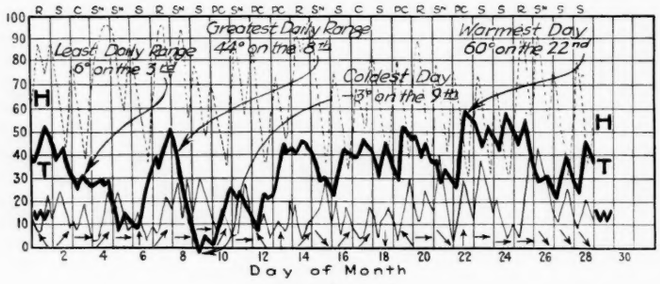
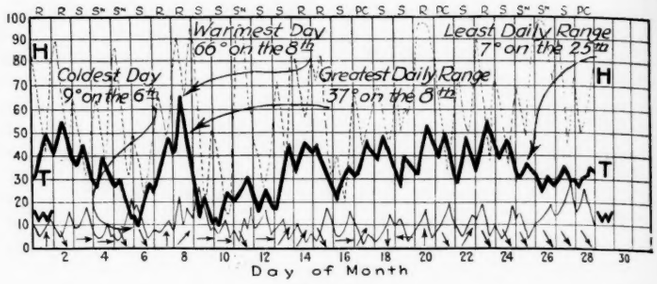
The Weather

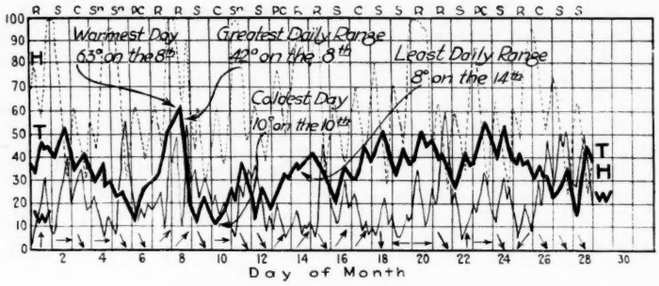
February, 1933



Pittsburgh

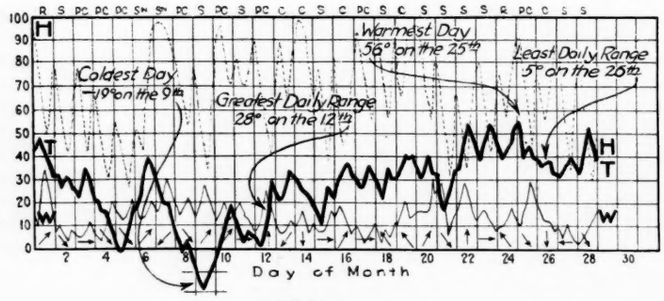


Boston

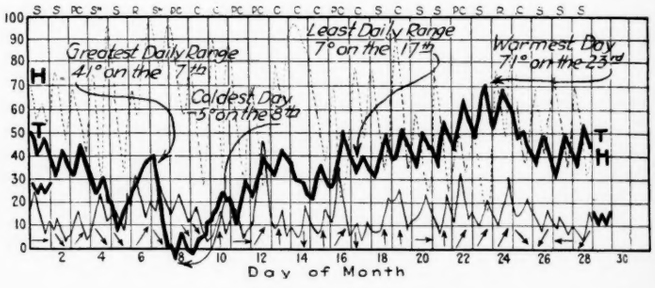


New York

(Hourly observation of the Relative Humidity Plotted on this Chart)



Chicago



St. Louis

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, deg. F.	63	66	60	56	71
Date of highest temperature	8	8	22	25	23
Lowest temperature, deg. F.	10	9	-3	-19	-5
Date of lowest temperature	10	6	9	9	8
Greatest daily range, deg. F.	42	37	44	28	41
Date of greatest daily range	8	8	8	12	7
Least daily range, deg. F.	8	7	6	5	7
Date of least daily range	14	25	3	26	17
Mean temperature for month, deg. F.	33.8	33.7	33.0	26.2	35.1
Normal mean temperature for month, deg. F.	31.3	28.8	32.3	26.3	34.8
Total precipitation, this month, inches	2.98	3.77	1.67	1.22	0.96
Total snowfall, this month, inches	11.5	20.6	5.4	12.7	1.5
Normal precipitation, this month, inches	3.82	3.37	2.62	2.14	2.56
Total wind movement, this month, miles	12,673	6,749	8,944	8,603	8,748
Average hourly wind velocity, miles	18.9	10.0	13.3	12.8	13.0
Prevailing direction of wind	N.W.	N.W.	W.	S.W.	N.W.
Number of clear days	10	11	6	12	11
Number of partly cloudy days	6	10	7	8	9
Number of cloudy days	12	7	15	8	8
Number of days with precipitation	12	8	12	4	5
Number of days with snowfall	4	5	7	2	2
Snow on ground, at end of month	None	4.9	None	None	None

Plotted from records especially compiled for HEATING AND VENTILATING by the United States Weather Bureau.
Heavy lines indicate temperatures in degrees F. Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings at 8 a.m., 12 m., and 8 p.m.
S—clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow. Arrows fly with prevailing directions of wind.

MAY 9 1933

Heating and Ventilating

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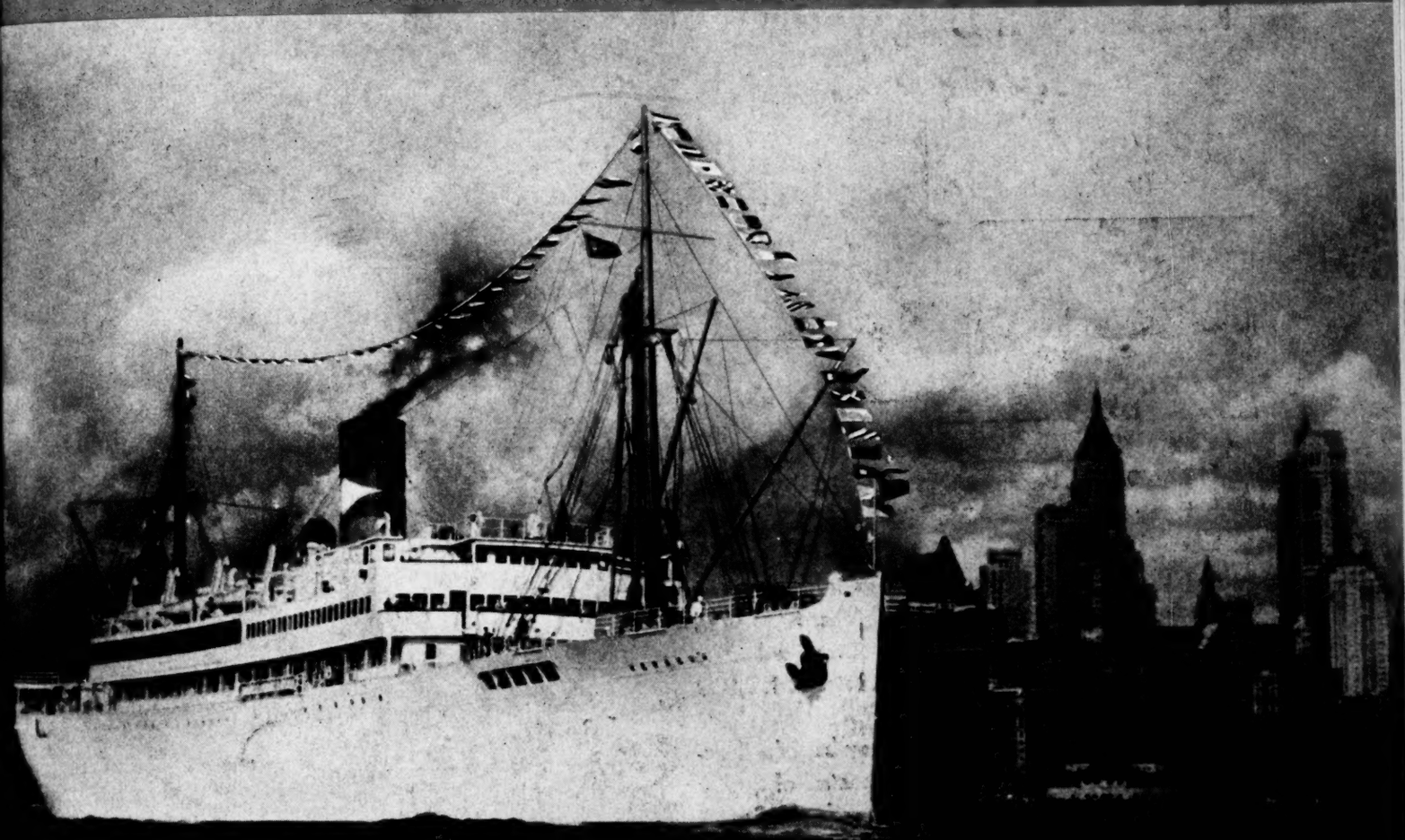

May
1933